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UNIX上の音声研究用ツール

― *SpeechTools Commands Manual* ―

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第１章　はじめに

このマニュアルでは、音声の分析・合成等を行なうコマンドについて、使い方と機能を説明する。ここで、取り上げるコマンドとライブラリィを総称してSpeechToolsと言うことにする。

なお、ここで取り上げるコマンドは、/usr/local/st/bin にインストールされているので、ホームディレクトリのファイル '.login' や '.cshrc' のコマンドのサーチパスに、/usr/local/st/binを加えなければならない。

このマニュアルは、４章から構成されている。第２章では、SpeechToolsの多くのコマンドで実現されている一貫した使用方法を基本編と応用編に分けて説明する。第３章では、各コマンドを機能別に分類する。第４章では、SpeechToolsに含まれる便利なコマンドを紹介する。そして、付録には各コマンドのマニュアルを付けた。

現在、これらのコマンドは、SUN3、SUN4、MASSCOMP、ALLIANT、VAXの各シリーズで動作することを確認している。

謝辞

コマンドの作成に関して多くの方より御助言と御助力を頂きました。聴覚研究室に滞在していたAlain de Cheveigne氏からは有益な御助言を、さらに名古屋大学の板倉文忠先生、北海道大学の宮永喜一先生からは多くの資料と御助言を頂戴しました、ここに深く感謝いたします。また、本マニュアルを執筆する際して、草稿段階より多くの御助言を頂きました聴覚研究室の東倉洋一室長、山田玲子氏、Andrew Duchon氏ならびに各位に感謝いたします。

第２章　コマンドの使い方

この章では、SpeechToolsの多くのコマンドで実現されている一貫した使用方法を、基本編と応用編に分けて説明する。基本編では、一貫した使用方法について、応用編では、例を通じて使い方を説明する。

２．１　使い方（基本編）

このSpeechToolsのコマンドの多くは、一貫した同じ方法で使うことができる。以下の説明では、下線部がユーザが入力している部分で、% はＵＮＩＸのプロンプトでありユーザの入力を促している。

①ＵＮＩＸのプロンプトの出ている状態でコマンド名を入力する。

```
% fft_run
Calculate DFT running spectra.
usage :: fft_run filename
         fft_run -o arguments

Defaults are as follows.
SAMPLING FREQUENCY : 20.0 kHz
WINDOW LENGTH      : 30 msec
WINDOW TYPE        : HANNING
FFT LENGTH         : 1024
FRAME PERIOD       : 5 msec
PREEMPAHSIS        : 0.98
INPUT FILE NAME    : TMP.DAT short
OUTPUT FILE NAME   : TMP.DFT float
```

コマンドは、簡単な説明と使い方と既定値を画面に表示する。

```
Calculate DFT running spectra.
```

これが、コマンドの簡単な説明である。

```
usage :: fft_run filename
         fft_run -o arguments
```

これが、コマンドの使い方である。

各コマンドは、あらかじめ既定値と呼ばれる値を持っている。コマンドを使うときは、もし必要ならば、その既定値を変更して使わなければならない。

コマンドには、大きく分けて２通りの使い方がある。コマンドの引数にファイル名を与える方法と、－ｏを与え、以下既定値の変更を引数に与える方法である。これらの方法を通じてコマンドの持つ既定値を変更し、コマンドを実行する。

以下に、既定値の例を示す。

```
Defaults are as follows.
SAMPLING FREQUENCY : 20.0 kHz
WINDOW LENGTH      : 30 msec
WINDOW TYPE        : HANNING
FFT LENGTH         : 1024
```

```
FRAME PERIOD        : 5 msec
PREEMPAHSIS         : 0.98
INPUT FILE NAME     : TMP.DAT short
OUTPUT FILE NAME    : TMP.DFT float
```

既定値は、以下の形式で指定されている。

変数名　：　既定値　単位

たとえば、

SAMPLING FREQUENCY : 20.0 kHz

では、SAMPLING FREQUENCY が変数名で、20.0 が既定値で、kHz が単位である。

②既定値をファイルに書き込む。

```
% fft_run > envfile
Calculate DFT running spectra.
usage :: fft_run filename
         fft_run -o arguments

Defaults are as follows.
```

既定値をファイルに一旦取り込むにはリダイレクション(redirection)を使う。リダイレクションによって、標準出力装置に出力されていたものがファイルに書き込まれる。

ここで注意すべきは、'Defaults are as follows.'以下の既定値だけが標準出力装置に出力されているということである。

確認のために、catを使ってファイルの内容を表示させて見ると次の様になる。

```
% cat envfile
SAMPLING FREQUENCY : 20.0 kHz
WINDOW LENGTH      : 30 msec
WINDOW TYPE        : HANNING
FFT LENGTH         : 1024
FRAME PERIOD       : 5 msec
PREEMPAHSIS        : 0.98
INPUT FILE NAME    : TMP.DAT short
OUTPUT FILE NAME   : TMP.DFT float
```

これを、エディッタを使って編集して望みの既定値を設定する。

```
% fft_run envfile
.....................................................................
.....................................
!120
```

多くのコマンドは、実行すると記号'.'が、標準出力装置に表示され、最後に記号'!'と数値を表示する。数値は、記号'.'の数に等しく大きなループの回数を表わしている。

③－ｏオプションを使う。

第１引数に－ｏを指定すると、コマンドに、ファイルを使用せずに既定値を変更することができる。この使い方は、特にシェルスクリプトを使用してバッチ処理を行なうときに有効である。

```
% fft_run -o "FRAME PERIOD : 10 msec" "FFT LENGTH : 4096"
```

注意事項

・既定値を変更しないときは、その既定値を書かなければ良い。
・設定する既定値の順序は問わないが、２回以上与えると後の方が有効となる。
・全ての文字列では、大文字と小文字の区別を行なってる。

変数名について

各コマンドの変数名は、おおよそ同じなのでｌｐｃ＿ｒｕｎを例にして変数名について説明する。ｌｐｃ＿ｒｕｎの変数を表２．１にまとめた。

表２．１　ｌｐｃ＿ｒｕｎの変数

変数名	意　味	既定値	単位	
SAMPLING FREQUENCY	標本化周波数	20.0	kHz	①
WINDOW LENGTH	分析窓長	30.0	msec	②
WINDOW TYPE	分析窓の種類	HANNING		③
FFT LENGTH	ＤＦＴの長さ	1024		④
FRAME PERIOD	分析フレームの周期	5.0	msec	⑤
PREEMPAHSIS	高域強調のパラメータ	0.98		⑥
ORDER OF LPC	線形予測係数の次数	16		⑦
INPUT FILE NAME	入力のデータファイル名	TMP.DAT	short	⑧
OUTPUT LPC FILE NAME	出力のLPCデータのファイル名	TMP.LPC	float	⑨
OUTPUT ALPHA FILE NAME	出力の線形予測係数のファイル名	TMP.ALP	float	⑩

①には、音声データの標本化周波数を指定する。
②には、分析窓長を指定する。
③には、以下のものから選択できる。

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

④は、２ⁿの正の整数である。ただし、標本化周波数×分析窓長よりも長くなくてはならないが、上限は、ない。
⑤には、分析のフレーム周期を指定する。もし、分析窓長よりも長い場合は、分析フレームは、重なりがないことになる。
⑥は、高域強調に関する係数で、０～１の値を取る。０を与えると高域強調しない。
⑧⑨⑩には、ファイル名を与えるが、単位に示されたデータ型のバイナリィファイルである。通常、音声データに関してはshortを用いる。単位がasciiの場合に限りそのファイルは、アスキーファイルである。また、ファイル名の指定に際しては、絶対パスで指定することができるが、特殊文字（'～'，'．'，'．．'）を用いて相対パスで指定することもできる。なお、ワイルドカードを表す特殊文字（'＊'，'？'）は、使えない。

２．２　使い方（応用編）

例えば、多くのデータを一度に同じ方法で分析したり、あるいは、ある一定の条件で異なったパラメータを用いて合成音を作ったりと、定型的な作業を連続して行なうときがよくある。この様な一連の定型的な処理のことをバッチ(batch)処理と言う。

ＵＮＩＸでは対話的に処理を行なうことが基本となっているが、バッチ処理を行なう場合にはシェルスクリプト(shell script)を用いるのが簡単な方法である。シェルとはＵＮＩＸの対話的なユーザーインターフェースそのものであり、ユーザーからの要求を解釈して実行するものである。

他の多くのオペレーティングシステムとは異なり、ＵＮＩＸでは、シェルは、一つのコマンドであり、そのため、ＵＮＩＸには多くのシェルが存在する。代表的なものとして、ｓｈ（Bourneシェルまたは単にシェルという）とｃｓｈ（Ｃシェルという）がある。シェルスクリプトとは、シェルの文法に従って記述するプログラムのことである。

このマニュアルでは、シェルにはｃｓｈを用いる。以下、例題にしたがっていくらかのｃｓｈの説明を加えるが、詳しくは正著にゆずる。例えば、ファイルを編集して、シェルを実行するのには、ファイルに実行許可の指定を行なわなければならないことなどは、ここでは説明しない。

ここで述べる例は極めて簡単なものであるが、これらのものは基本的なものであり、組み合せることによって多くの複雑なことができる。よって、ここで取り上げた例を修得することを勧める。

［例題　１：　ＤＦＴ分析］

```
〔dft.csh〕
#! /bin/csh -f
set     DATA = MAU10018
fft_run -o ¥
        "SAMPLING FREQUENCY : 20.0 kHz"¥
        "WINDOW LENGTH      : 50 msec"¥
        "WINDOW TYPE        : HANNING"¥
        "FFT LENGTH         : 4096"¥
        "FRAME PERIOD       : 10 msec"¥
        "PREEMPAHSIS        : 0.98"¥
        "INPUT FILE NAME    : $DATA.AD  short"¥
        "OUTPUT FILE NAME   : $DATA.DFT float"
```

ｃｓｈの起動

まず、第１行目では、ｃｓｈを使用することを宣言している。記号'#'は、通常、注釈（コメント）を表わすが、ファイルの一番最初の行に'#! /bin/csh -f'と記述すると以下このファイルを、ｃｓｈの文法に従って記述でき、かつ、実行されることを意味する。ｃｓｈを使うときは必ず第１行目にこれを書かなければならない。もし、この行がファイルの第１行目にないときはｃｓｈの記法は使用できないので、文法的なエラーが生じる。

'-f'は 'csh' のオプションで、素早くｃｓｈを起動することを意味する。ｃｓｈは、通常、ユーザのホームディレクトリィにある'.cshrc'ファイルを読んだ後、起動されるが、'-f'オプションを付けておくと'.cshrc'ファイルを読まないで起動される。このことによって、'.cshrc'ファイルに記述されたエイリアス(alias)等の定義は、有効にならない。しかし、環境変数（定義済シェル変数）は、プロセス生成時に継承されるので、例えば、環境変数の１つである'path'の指定は、継承される。

シェル変数を定義するには

'set'を使って変数を定義するには、

```
set  変数名 = 値
```

とする。値には、数値、文字列、リストがある。リストは、記号'('と記号')'によって作られる。ここでは、

```
set     DATA = MAU10018
```

'DATA'という変数名に'MAU10018'という文字列が代入されている。変数を使用するときは変数名の前に記号'$'を付ける。'$DATA.AD'と'$DATA.DFT'は、それぞれ、'MAU10018.AD'と'MAU10018.DFT'に対応している。

一行に収めるには

記号'¥'は、バックスラシュである。ｃｓｈでは、バックスラシュによって便宜的に行を続けることができる。'－ｏ'オプションを使うときは、１行に全ての既定値を書かなければならないので、バックスラシュによって一つの行としなければならない。

［例題　２：　ＬＰＣ分析］

```
〔lpc.csh〕
#! /bin/csh -f
foreach FILE ( $* )
        lpc_run -o¥
                "SAMPLING FREQUENCY      : 20.0 kHz"¥
                "WINDOW LENGTH           : 30 msec"¥
                "WINDOW TYPE             : HANNING"¥
                "FFT LENGTH              : 1024"¥
                "FRAME PERIOD            : 5 msec"¥
                "PREEMPAHSIS             : 0.98"¥
                "ORDER OF LPC            : 16"¥
                "INPUT FILE NAME         : $FILE short"¥
                "OUTPUT LPC FILE NAME    : $FILE.LPC float"
                "OUTPUT ALPHA FILE NAME  : $FILE.ALP float"
end
```

コマンド引数の渡し方

コマンド行からファイル名等を渡したいときがよくある。'$*'は、コマンド行のリスト全てになる。'$*'は、ｃｓｈでは、コマンド行のリストである。具体的に述べると、コマンド行で、以下の様に入力されると

```
% lpc.csh FSU10018.AD FKN10018.AD MAU10018.AD MHT10018.AD
```

'$1'は、FSU10018.AD、'$2'は、FKN10018.AD、'$3'は、MAU10018.AD、'$4'は、MHT10018.ADになる。

なお、'$1'と'$argv〔1〕'ならびに'$*'と'$argv〔*〕'は、表記が違うが同じ意味である。

'argv'という変数は、ｃｓｈの方であらかじめ定義されている変数リストである。このように、ｃｓｈの方であらかじめ定義された変数が幾つかある。

一般的に、リストのｎ番目を参照するときは、'$変数名〔n〕'とし、リストの長さは、'$#変数名'とすれば良い。

例えば、以下のようなことが可能である。

```
% set list = ( a b c d )
% echo $list
a b c d
% echo $#list
4
% echo $list〔2〕
b
```

繰り返し実行の仕方

繰り返し実行させるときには、'foreach'を使うのが１つの方法である。'foreach'は、'end'までを繰り返し実行する。

'foreach FILE ($*)'では、'FILE'は仮変数であり、リストの先頭に順次、単一化されて行く。リストが空になった時点でこのループは終了する。

［例題　３：　ローパスフィルタリング］

```
〔lpf.csh〕
#! /bin/csh -f
set LIST = `cat TEMPLATE`
foreach FILE ( $LIST )
        lpf1 -o¥
                "SAMPLING FREQUENCY : 20.0 kHz"¥
                "CUT OFF FREQUENCY  : 100.0 Hz"¥
                "INPUT FILE NAME    : $FILE short"¥
                "OUTPUT FILE NAME   : $FILE.LPF short"
end
```

外部ファイルからの入力

外部ファイルからファイル名のリストを読み込んで実行するには、

```
set LIST = `cat TEMPLATE`
```

とする。ここで、記号'`'は、バッククォートであり、バッククォートで囲まれた文字列は、ｃｓｈによって評価される。例ではファイル 'TEMPLATE' を出力する。出力された内容が、変数 'LIST' に代入される。

また、外部コマンドを実行して変数に代入するには、以下の様にすれば良い。

```
set LIST = `ls *.AD`
```

［例題　４：　ピッチ抽出］

```
〔pitch.csh〕
#! /bin/csh -f
if ( $#argv != 3 ) then
        echo "usage::"
        echo "pitch.csh 〈file〉 〈min〔Hz〕〉 〈max〔Hz〕〉"
        exit -1
endif
#
set DATA = $1
set MIN  = $2
set MAX  = $3
#
pitcher -o ¥
        "SAMPLING FREQUENCY : 20.0 kHz"¥
        "WINDOW LENGTH      : 30 msec"¥
        "WINDOW TYPE        : HANNING"¥
        "FRAME PERIOD       : 5 msec"¥
        "MINIMUM FREQUENCY  : $MIN Hz"¥
        "MAXIMUM FREQUENCY  : $MAX Hz"¥
        "THRESHOLD POWER    : 40 dB"¥
        "INPUT FILE NAME    : $DATA short"¥
        "PITCH FILE NAME    : $DATA.PIT float"¥
        "POWER FILE NAME    : $DATA.POW float"
```

目的に応じて

しばしば、コマンドラインから条件を変えて分析をしたいときがある。この例では、分析対象のファイル名とピッチ抽出の最大と最小の基本周波数を指定している。

忘れるということを忘れないように

ｃｓｈやＣ言語などを使ってプログラムを作るとき、少し時間がたち日もたつと、使い方を忘れてしまったり、どんなことをしてくれるプログラムなのかを忘れてしまったりするときがよくある。引数リストの順番は、必ずといっていいほど忘れてしまう。もし要求される引数の数が違ったら、実行しないようにするよう心掛けると良い。また、引数の数が間違っていたら使い方を簡単に説明するようにプログラムするのが賢明な方法である。

［例題　５：　データの切り出し］

```
〔cut.csh〕
#! /bin/csh -f
echo -n "Plase input a file name : "
set DATA = $<
/bin/ls -l $DATA
if ( $status ) then
        exit -1
endif
echo -n "Offset 〔byte〕 : "
set OFFSET = $<
echo -n "Length 〔byte〕 : "
set LENGTH = $<
#
subseq -o¥
        "SOURCE FILE NAME : $DATA"¥
        "RESULT FILE NAME : $DATA.CUT"¥
        "SIZE OF ARRAY    : 1 byte"¥
        "OFFSET           : $OFFSET"¥
        "LENGTH           : $LENGTH"
```

会話的に使用するには

'echo -n'は、メッセージを出力した後に改行しないことを表わす。そして、'$<'によって入力を待つ。

```
set DATA = $<
```

入力された文字列は変数 'DATA' に代入される。

失敗を発見する

このような方法で、ｃｓｈでも会話的に処理を行なうことができるが、会話的に処理を行なうとき注意しなければならないのは入力ミス等である。ｃｓｈでは、入力ミス等を発見するための機能が、あまり用意されてはいない。

直前のコマンド等が正常に終了したかどうかを確かめるには、変数 '$status' を参照する。

```
/bin/ls -l $DATA
if ( $status ) then
        exit -1
endif
```

'bin/ls -l $DATA'によってファイル名をリストし、かつファイルの長さを利用者に提示している。もしファイルが存在しなかったときは、'$status' には０以外の数字が入っている。ＵＮＩＸの多くのコマンドは、正常終了したときは０を、異常終了したときは０以外の数字を返すようになっている。

本マニュアルで説明するコマンドも多くは、この慣例に従って、正常終了したときは０を、異常終了したときは－１を返すようになっている。

［例題　５：　バイナリィファイルの作成］

```
[cut.csh]
#! /bin/csh -f

cat 〈〈 EOF 〉 TMP.ASC
  0.0   120.0
100.0   100.0
EOF
#
atobi -o¥
        "SAMPLING FREQUENCY : 20.0 kHz"¥
        "FRAME PERIOD       : 5 msec"¥
        "TOTAL LENGTH       : 1000 msec"¥
        "NUMBER OF SET      : 1"¥
        "INPUT FILE NAME    : TMP.ASC ascii"¥
        "OUTPUT FILE NAME   : TMP.BIN float"
```

ヒアドキュメントの利用

ヒアドキュメント（埋め込み文書）とは、ｃｓｈ中に文書を埋め込む方法である。例では、

```
cat 〈〈 EOF 〉 TMP.ASC
  0.0   120.0
100.0   100.0
EOF
```

この部分が、ヒアドキュメントである。記号'〈〈'はインラインでの入力の切り替えを指定する。'cat 〈〈 EOF'は、文字列 'EOF'がくるまでを読み込んで、それを出力する。この例では、'cat 〈〈 EOF 〉 TMP.ASC'となっているので、出力はリダイレクションによってファイル'TMP.ASC'に出される。

コマンド'atobi'は、ファイル'TMP.ASC'を読み込んで、線形補間によってバイナリィデータを作成する。ファイル'TMP.ASC'の第１列目は時刻［単位：ｍｓｅｃ］であり、第２列目は、なんらかの値（例えば基本周波数の値）である。

第３章　コマンドの機能

この章では、SpeechToolsのコマンドを機能別に分類する。

３．１　アレイを扱うコマンド

ｓｕｂｓｅｔ	データファイルから一部を切り出す。
ｔｒａｎｓｐｏｓｅ	データファイルのアレイを転置する。

これらのコマンドは、バイナリィ形式のデータをアレイ（配列）として見なし、アレイの一部を切り出したり、アレイを転置する。これらのコマンドは、入出力のファイルの形式は、共に様々な型のバイナリィデータのファイルである。

３．２　補間を行なうコマンド

ａｔｏｂｉ	補間によってバイナリィデータを求める。

時系列データのサンプル点が不定期な場合、データを時刻に対して補間する必要がある。このコマンドでは入力にはアスキー形式のファイルを使い、バイナリィ形式のファイルが作成される。アスキー形式のファイルには時刻と数値を記す。

例えば、以下のようなファイルを作る。

```
100     100
200     300
500     150
```

１列目が時刻で単位は、ｍｓｅｃである。２列目のデータはなんらかの数値で単位は、コマンドが関知しなくてよい。

３．３　音声信号を変換するコマンド

ｃｈａｎｇｅ＿ａｍｐ	振幅を調整する。
ｐｉｃｏｌａ	音声データの時間長を伸縮させる。
ｔａｐｅｒ	音声データにｔａｐｅｒ関数を掛け合わせる。

これらのコマンドは、音声信号データを取り扱っているので、入出力のファイルの形式は、共にshort型のバイナリィデータのファイルである。

３．４　データを平滑化するコマンド

ｌｓｔｓｑ＿ｓｍｏｏｔｈ	最小２乗法によりデータを平滑化する。
ｍｅｄｉａｎ＿ｓｍｏｏｔｈ	ある区間内の中間値を求めてデータを平滑化する。

これらのコマンドは、入出力のファイルの形式は、共にfloat型のバイナリィデータのファイルである。

３．５　ＤＦＴに関するコマンド

ｄｆｔ＿ｆｏｒｗａｒｄ	音声データをＤＦＴ変換して複素数を求める。
ｄｆｔ＿ｉｎｖｅｒｓｅ	複素数から音声データを逆ＤＦＴ変換で求める。

３．６　特徴点を求めるコマンド

ｆｉｎｄ＿ｚｅｒｏｃｒｓ	零交差点を求める。

３．７　音声分析を行なうコマンド

ａｕｄｆｉｌ	適応Ｑ型鍋牛フィルタ分析を行なう。
ｄｃｅｐ	デルタケプストラム分析を行なう。
ｆｆｔ＿ｒｕｎ	ＤＦＴパワースペクトルを求める。
ｆｔｒａｃｋ	LPC分析を行ないフォルマント周波数を求める。
ｌｐｃ＿ｃｅｐｓｔ	LPC分析を行ないケプストラム係数を求める。
ｌｐｃ＿ｒｕｎ	LPC分析を行ないスペクトル包絡を求める。
ｐａｒｃｏｒ	PARCOR分析を行なう。
ｐｅａｋ＿ｐｉｃｋ	スペクトル包絡からピークを抽出する。
ｐｉｔｃｈｅｒ	極性相関法によりピッチ抽出を行なう。
ｚｅｒｏｃｒｓ	零交差分析を行なう。

３．８　音声合成に関するコマンド

ｓｙｎ＿ｃａｓｃａｄｅ	カスケード型フォルマント合成を行なう。
ｓｙｎ＿ｐａｒｃｏｒ	PARCOR合成を行なう。

出力は、short型のバイナリィデータのファイルである。

３．９　距離値を計算するコマンド

ｃｅｐ＿ｄｉｓｔ	ケプストラム距離を求める。
ｅｕｃｌｉｄ＿ｄｉｓｔ	ユークリッド距離を求める。
ｓｐｃ＿ｄｉｓｔ	スペクトル距離を求める。

３．１０　フィルタリングを行なうコマンド

ｅｍｐｈａｓｉｓ	１次差分を行なう。
ｈｐｆｌ	１次のＩＩＲ高域通過フィルタリングを実行する。
ｌｐｆｌ	１次のＩＩＲ低域通過フィルタリングを実行する。
ｓｙｎ＿ｐｏｌｅ	２次の帯域通過フィルタリングを実行する。
ｓｙｎ＿ｚｅｒｏ	２次の帯域阻止フィルタリングを実行する。

これらのコマンドは、音声信号をフィルタリングすることを目的としているので、入出力のファイルの形式は、short型のバイナリィデータのファイルである。

３．１１　軸を変換するコマンド

ｄｆｔ＿ｂａｒｋ	周波数軸を［Ｈｚ］から［ｂａｒｋ］に変化する。
ｄｆｔ＿ｍｅｌ	周波数軸を［Ｈｚ］から［ｍｅｌ］に変化する。

これらのコマンドは、スペクトル分析の結果を扱っているので、入出力のファイルの形式は、float型のバイナリィデータのファイルである。

３．１２　信号音を作成するコマンド

ｎｏｉｓｅ＿ｗａｖｅ	ノイズを生成する。
ｒｅｃｔ＿ｗａｖｅ	方形波を生成する。
ｓａｗ＿ｗａｖｅ	のこぎり波を生成する。
ｓｉｎｅ＿ｗａｖｅ	正弦波を生成する。
ｔｒｉ＿ｗａｖｅ	三角波を生成する。

これらのコマンドは生成した信号をshort型のバイナリィデータ形式で出力する。

３．１３　ＡＲＭＡに関するコマンド

ａｒｍａ	ＡＲＭＡ分析を行なう。
ａｒｍａ＿ｆｒｅｑ	ＡＲＭＡパラメータから極／零周波数を求める。
ａｒｍａ＿ｓｐｃ	ＡＲＭＡパラメータからスペクトル包絡を求める。

３．１４　ファイル名の操作に関するコマンド

ｆｉｌｅｓｈｕｆｆｌｅ	ファイル名のリストをランダムに並べ変える。
ｍａｋｅ＿ｐａｉｒ	ファイル名の組合せを作る。

これらのコマンドは、リストをアスキー形式で含んだファイルを入出力する。

３．１５　微積分を行なうコマンド

ｄｉｆｆｅｒｅｎｔｉａｌ	ｎ回微分を行なう。
ｉｎｔｅｇｒａｌ	ｎ回積分を行なう。

これらのコマンドは、入出力のファイルの形式は、共にfloat型のバイナリィデータのファイルである。

第４章　ユーティリティ

この章では、SpeechToolsのユーティリティを紹介する。ここで紹介するコマンドの使い方は、第２章で説明した方法と異なるので、詳しくは、各マニュアルを参照されたい。

４．１　データ形式の変換を行なうコマンド

ＵＮＩＸにおいてデータの形式には２種類ある。

・アスキー(ascii)形式

アスキー文字で構成されテキストとして扱うことができ、比較的扱いやすい。例えば、emacsやviなどのエデイッタを使って編集することができる。

・バイナリィ(binary)形式

非アスキー文字で構成されテキストとして扱うことができないので、扱いにくいが、コンパクトにデータを保存でき、また、低レベルでデータの読み書きができる。バイナリィ形式のデータには、ＵＮＩＸが扱うことのできるデータ型（char,int,short,long,float,double,etc.）がある。

SpeechToolsでは、アスキー形式のデータとバイナリィ形式のデータ共にある。そこで、データの変換を行なうコマンドを用意した。

ａｃａｔ	アスキー形式からバイナリィ形式への変換を行なう。
ｂｃａｔ	バイナリィ形式からアスキー形式への変換を行なう。

また、short型のバイナリィデータは音声信号の入出力に用いられ、float型のバイナリィデータは音響分析等によって作成されるので、float型からshort型に変換する必要がしばしば生じるので次のコマンドを用意した。

ｃｖ	float型からshort型のバイナリィデータに変換する。

ただし、これらのコマンドでは、データのオーバーフローは、事前に調べていないのでエラーを生じることがある。

４．２　表データに対する操作を行なうコマンド

ここでは、表データ（アスキー形式）を扱うコマンドについて説明する。表データとは、以下のようなもので列と行によって特徴付けできる。

［表データの例］

```
a       1       200.0
b       2       300.0
c       3       100.0
```

この［表データの例］では、３列４行のデータで、１列目にはアルファベットが、２列目には整数が、３列目には実数が記されている。この様な表データがファイルに保存されているとき１列目を取り出したり、１列目と３列目を取り出したり、また、４列目に新しくデータを付け足したりすることがよくある。少ない行数のデータであればエディッタを用いればいいが、行数が長かったり、操作が定型的である場合には何かコマンドで実行する方が賢明である。幸いにしてＵＮＩＸにはこの種の仕事を簡単に行なうことのできるａｗｋというコマンドが用意されているが、ａｗｋは機能が多くその分使い方も繁雑である。そこで、SpeechToolsでは、列に対してのみの分割と併合を行なうコマンドを用意している。

ｍｅｒｇｅ	列の併合を行なう。
ｓｅｐａｒａｔｅ	列による分割を行なう。

４．３　算術計算を行なうコマンド

標準入力装置からデータを取り込んで、算術計算をした後、その結果を標準出力装置に出力するｓｍａｔｈというコマンドを用意している。

付　録.

NAME

acat – convert ascii data (from 'stdin') to binary format file.

SYNOPSIS

acat [–s | –i | –d | –f] *filename*

acat –help

DESCRIPTION

acat converts ascii data from the standard input to binary format file. Data format can be one among :

-s short
-i integer
-d double
-f float (default)

If no option is present, the '-f' option is assumed. Out-of-range data will cause an error.

SEE ALSO

bcat(L)

EXAMPLE

```
acat a.float < a.ascii
acat -s a.short < a.ascii
```

AUTHOR

Seiichi TENPAKU

NAME

arma – Estimation of ARMA parameters.

SYNOPSIS

arma *filename*
arma –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **arma**.
The *parameter*s of **arma** are listed below ::

SAMPLING FREQUNECY	: 20.0 kHz
AR ORDER (< 35)	: 16
MA ORDER (< 15)	: 4
THRESHOLD OF SEARCHING INPUT	: 12.0
DURATION FOR AVOIDING PERTURBATION	: 2.0 msec
AVERAGE INTERVAL OF VARIED PAR	: 3.0 msec
DURATION OF STATIONARY VARIANCE	: 10.0 msec
INITIAL TRAINING DURATION	: 5.0 msec
INTERVAL OF OUTPUT PARAMETERS	: 2.0 msec
MODEL REDUCTION THRESHOLD	: -0.0001
DATA FILE NAME	: TMP.DAT short
ARMA OUTPUT FILE NAME	: TMP.ARMA float
F0 OUTPUT FILE NAME	: TMP.F0 float
RESIDUAL OUTPUT FILE NAME	: TMP.RES float

When **arma** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

AR ORDER (< 35)
Sets the AR order. The value must be less than 35.

MA ORDER (< 15)
Sets the MA order. The value must be less than 15.

THRESHOLD OF SEARCHING INPUT
Sets the threshold of searching input.

DURATION FOR AVOIDING PERTURBATION
Sets the duration for avoiding perturbation.

AVERAGE INTERVAL OF VARIED PAR
Sets the average interval of varied par.

DURATION OF STATIONARY VARIANCE
Sets the duration of stationary variance.

INITIAL TRAINING DURATION
Sets the initial training duration.

INTERVAL OF OUTPUT PARAMETERS
Sets the interval duration of output ARMA parameters and F0.

MODEL REDUCTION THRESHOLD
Sets the model reduction threshold. When the value is nagative, the model reduction is not used.

DATA FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

ARMA OUTPUT FILE NAME
Sets the file name for the output of estimated ARMA parameters. The format of output data is single-floating binary.

F0 OUTPUT FILE NAME
Sets the file name for the output of estimated fundamental frequency. The format of output data is single-floating binary.

RESIDUAL OUTPUT FILE NAME
Sets the file name for the output of residual data. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/~/', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% arma
Estimation of ARMA parameters.
usage :: arma filename
        arma -o arguments

Defaults are as follows.
SAMPLING FREQUNECY                  : 20.0 kHz
AR ORDER ( < 35 )                   : 16
MA ORDER ( < 15 )                   : 4
THRESHOLD OF SEARCHING INPUT        : 12.0
DURATION FOR AVOIDING PERTURBATION  : 2.0 msec
AVERAGE INTERVAL OF VARIED PAR      : 3.0 msec
DURATION OF STATIONARY VARIANCE     : 10.0 msec
INITIAL TRAINING DURATION           : 5.0 msec
INTERVAL OF OUTPUT PARAMETERS       : 2.0 msec
MODEL REDUCTION THRESHOLD           : -0.0001
DATA FILE NAME                      : TMP.DAT short
ARMA OUTPUT FILE NAME               : TMP.ARMA float
F0 OUTPUT FILE NAME                 : TMP.F0 float
RESIDUAL OUTPUT FILE NAME           : TMP.RES float
example% arma > temp
Estimation of ARMA parameters.
usage :: arma filename
        arma -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUNECY                  : 20.0 kHz
AR ORDER ( < 35 )                   : 16
MA ORDER ( < 15 )                   : 4
THRESHOLD OF SEARCHING INPUT        : 12.0
DURATION FOR AVOIDING PERTURBATION  : 2.0 msec
AVERAGE INTERVAL OF VARIED PAR      : 3.0 msec
DURATION OF STATIONARY VARIANCE     : 10.0 msec
INITIAL TRAINING DURATION           : 5.0 msec
INTERVAL OF OUTPUT PARAMETERS       : 2.0 msec
MODEL REDUCTION THRESHOLD           : -0.0001
DATA FILE NAME                      : TMP.DAT short
ARMA OUTPUT FILE NAME               : TMP.ARMA float
```

F0 OUTPUT FILE NAME : TMP.F0 float
RESIDUAL OUTPUT FILE NAME : TMP.RES float
example% arma temp

SEE ALSO

arma_freq(L), arma_spc(L)

Miyanaga, Y., Miki, N., and Nagai, N. "Adaptive Identification of a Time-Varying ARMA Speech Model", IEEE Trans. Acoust., Speech, Speech, Signal Processing, vol. ASSP-34, No. 3, June 1986.

AUTHOR

Seiichi TENPAKU

NAME

arma_freq – Transfer ARMA parameters to frequency and bandwith.

SYNOPSIS

arma_freq *filename*
arma_freq –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **arma_freq**.
The *parameter*s of **arma_freq** are listed below ::

SAMPLING FREQUNECY	: 20.0 kHz
AR ORDER (< 35)	: 16
MA ORDER (< 15)	: 4
INPUT FILE NAME	: TMP.ARMA float
OUTPUT FILE NAME	: TMP.OUT float

When **arma_freq** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency.

AR ORDER (< 35)
Sets the AR order. The value must be less than 35.

MA ORDER (< 15)
Sets the MA order. The value must be less than 15.

INPUT FILE NAME
Sets the file name of input ARMA parameters data. The format of input data must be single-floating binary.

OUTPUT FILE NAME
Sets the file name for the output of frequency and bandwidth data. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

arma(L), arma_spc(L)

EXAMPLE

```
example% arma_freq
Transfer ARMA parameters to frequency and bandwith.
usage :: arma_freq filename
        arma_freq -o arguments

Defaults are as follows.
SAMPLING FREQUNECY      : 20.0 kHz
AR ORDER ( < 35 )       : 16
MA ORDER ( < 15 )       : 4
INPUT FILE NAME         : TMP.ARMA float
OUTPUT FILE NAME        : TMP.OUT float
example% arma_freq > temp
Transfer ARMA parameters to frequency and bandwith.
usage :: arma_freq filename
        arma_freq -o arguments
```

Defaults are as follows.

```
example% cat temp
SAMPLING FREQUNECY      : 20.0 kHz
AR ORDER ( < 35 )       : 16
MA ORDER ( < 15 )       : 4
INPUT FILE NAME         : TMP.ARMA float
OUTPUT FILE NAME        : TMP.OUT float
example% arma_freq temp
```

AUTHOR

Seiichi TENPAKU

NAME

arma_spc – Calculate the ARMA spectrum.

SYNOPSIS

arma_spc *filename*
arma_spc –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **arma_spc**.
The *parameter*s of **arma_spc** are listed below ::

SAMPLING FREQUNECY	: 20.0 kHz
AR ORDER (< 35)	: 16
MA ORDER (< 15)	: 4
FFT LENGTH	: 1024
VARIANCE MULTIPLY	: ON
INPUT FILE NAME	: TMP.ARMA float
OUTPUT FILE NAME	: TMP.SPC float

When **arma_spc** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency.

AR ORDER (< 35)
Sets the AR order. The value must be less than 35.

MA ORDER (< 15)
Sets the MA order. The value must be less than 15.

FFT LENGTH
Sets the number of DFT points. The value must be *2**n*. There are no restrictions as to the value.

VARIANCE MULTIPLY
Sets the option for variance multiply.

INPUT FILE NAME
Sets the file name of input ARMA parameters data. The format of input data must be single-floating binary.

OUTPUT FILE NAME
Sets the file name for the output of spectrum data. The format of output data is single-floating binary. The size of one frame is a half of "FFT LENGTH".

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

arma(L), arma_freq(L)

EXAMPLE

example% arma_spc
Calculate the ARMA spectrum.
usage :: arma_spc filename
arma_spc -o arguments

Defaults are as follows.

SAMPLING FREQUNECY	: 20.0 kHz
AR ORDER (< 35)	: 16

```
MA ORDER ( < 15 )          : 4
FFT LENGTH                 : 1024
VARIANCE MULTIPLY          : ON
INPUT FILE NAME            : TMP.ARMA float
OUTPUT FILE NAME           : TMP.SPC float
example% arma_spc > temp
Calculate the ARMA spectrum.
usage :: arma_spc filename
        arma_spc -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUNECY         : 20.0 kHz
AR ORDER ( < 35 )          : 16
MA ORDER ( < 15 )          : 4
FFT LENGTH                 : 1024
VARIANCE MULTIPLY          : ON
INPUT FILE NAME            : TMP.ARMA float
OUTPUT FILE NAME           : TMP.SPC float
example% arma_spc temp
```

AUTHOR

Seiichi TENPAKU

NAME

atobi – Convert the ASCII table to binary data.

SYNOPSIS

atobi *filename*
atobi –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **atobi**.
The *parameter*s of **atobi** are listed below ::

INTERPOLATION METHOD	: LINEAR
TOTAL LENGTH	: 1000.0 msec
FRAME PERIOD	: 5.0 msec
INPUT FILE NAME	: TMP.TBL ascii
OUTPUT FILE NAME	: TMP.OUT float

When **atobi** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

INTERPOLATION METHOD

Sets the type of interpolation function. The type of interpolation function can be chosen from the following table:

LINEAR
LAGRANGE
BLEND
SPLINE

FRAME PERIOD

Sets the duration of frame period.

TOTAL LENGTH

Sets the total duration.

INPUT FILE NAME

Sets the file name of the input ascii table. One example of the ascii table is:

100	10
200	20
300	30
400	40
500	50

The left column means the index times. The right column mean the values on each time.

OUTPUT FILE NAME

Sets the file name for the output of results. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

example% atobi
Convert the ASCII table to binary data.
usage :: atobi filename
atobi -o arguments

Defaults are as follows.

INTERPOLATION METHOD	: LINEAR
TOTAL LENGTH	: 1000.0 msec
FRAME PERIOD	: 5.0 msec

```
INPUT FILE NAME          : TMP.TBL ascii
OUTPUT FILE NAME         : TMP.OUT float
example% cat TMP.TBL
100     10
200     20
300     30
400     40
500     50
example% atobi -o "TOTAL LENGTH : 500.0 msec" "FRAME PERIOD : 50 msec"
!10
example% bcat TMP.OUT
10.000000
10.000000
10.000000
15.000000
20.000000
25.000000
30.000000
35.000000
40.000000
45.000000
```

SEE ALSO

bcat(L)

AUTHOR

Seiichi TENPAKU

NAME

audfil – Adaptive Q Cochlear Filtering.

SYNOPSIS

audfil *filename*
audfil –o *parameter ...*

USAGE

filename contains *parameters*, which are concerned with **audfil**.
The *parameters* of **audfil** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 2.0 msec
WINDOW TYPE	: HANNING
FRAME PERIOD	: 5.0 msec
ADAPTIVE Q LENGTH	: 2.0 msec
OFFSET TIME	: 0.0 msec
DURATION	: -1.0 msec
NOTCH DATA FILE NAME	: notchNx ascii
BPF DATA FILE NAME	: bpfNx ascii
INPUT FILE NAME	: TMP.DAT short
OUTPUT FILE NAME	: TMP.AUD float

When **audfil** is entered without any arguments, the command diplays the *parameters* and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing function.

WINDOW TYPE
Sets the type of windowing function. The type of windowing function can be chosen from the following table:

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

If an unknown type of windowing function is specified, the type of windowing function is automatically reduced to RECTANGULAR without messages.

FRAME PERIOD
Sets the duration of frame period.

ADAPTIVE Q LENGTH
Sets the duration of adaptive Q.

OFFSET TIME
Sets the offset to analyze data.

DURATION
Sets the duration to analyze data. When the value of "DURATION" is negative, the duration is adjusted to the file length of the input data.

NOTCH DATA FILE NAME
Sets the file name of Notch filter coefficients.

BPF DATA FILE NAME
Sets the file name of Band-pass filter coefficients.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results. The size of one frame is 64. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% audfil
Adaptive Q Cochlear Filtering.
usage :: audfil filename
        audfil -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 2.0 msec
WINDOW TYPE             : HANNING
FRAME PERIOD            : 5.0 msec
ADAPTIVE Q LENGTH       : 2.0 msec
OFFSET TIME             : 0.0 msec
DURATION                : -1.0 msec
NOTCH DATA FILE NAME    : notchNx ascii
BPF DATA FILE NAME      : bpfNx ascii
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.AUD float
example% audfil > temp
Adaptive Q Cochlear Filtering.
usage :: audfil filename
        audfil -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 2.0 msec
WINDOW TYPE             : HANNING
FRAME PERIOD            : 5.0 msec
ADAPTIVE Q LENGTH       : 2.0 msec
OFFSET TIME             : 0.0 msec
DURATION                : -1.0 msec
NOTCH DATA FILE NAME    : notchNx ascii
BPF DATA FILE NAME      : bpfNx ascii
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.AUD float
example% audfil temp
```

SEE ALSO

Hirahara, T. and Komakine, T. "Cochlear Filter Model with Adaptive Q Function" Transaction of ASJ Hearing Group, H-88-33, pp. 1-7, 1988 (Japanese)

AUTHOR

Seiichi TENPAKU

NAME

bcat – convert binary format files to ascii data ('stdout').

SYNOPSIS

bcat [–p *n*] [–t *format*] [–s | –i | –d | –f] *files* ...

bcat –help

DESCRIPTION

bcat converts binary format files to ascii data on the standard output. Data format can be one (only) among :

-s short
-i integer
-d double
-f float (default)

If no option is present, the '-f' option is assumed. With the '-t' option, you can use any *format* suported by the C library. The '-t' option dose not replace or override the data format option. There is no error checking. The '-p n' option splits data into multiple colums.

SEE ALSO

acat(L)

EXAMPLE

```
bcat a.float b.float c.float > data.ascii
bcat -d *.double
bcat -t '%4.1f' -f *.float
bcat -p 3 -t '%4.1f' -f *.float
```

AUTHOR

Seiichi TENPAKU

NAME

cep_dist – LPC Cepstrum Distance

SYNOPSIS

cep_dist *filename*
cep_dist –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **cep_dist**.
The *parameter*s of **cep_dist** are listed below ::

ORDER OF CEPSTRUM	: 16
ORIGINAL FILE NAME	: TMP.ORG float
REFERENCE FILE NAME	: TMP.REF float
DIFFERENCE FILE NAME	: TMP.DIS float
INFORMATION FILE NAME	: TMP.IFO ascii

When **cep_dist** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

ORDER OF CEPSTRUM
Sets the order of cepstrum coefficients.

ORIGINAL FILE NAME
Sets the file name of input data. The format of input data must be single-floating binary. There are no restrictions as to the file length.

REFERENCE FILE NAME
Sets the file name of input data. The format of input data must be single-floating binary. The file length of "REFERENCE FILE NAME" must be equal to the file length of "ORIGINAL FILE NAME".

DIFFERENCE FILE NAME
Sets the file name for the output of differences in each frame. The format of output data is single-floating binary.

INFORMATION FILE NAME
Sets the file name for the output of results.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

lpc_cepst(L), dtw_dist(L), euclid_dist(L), spc_dist(L)

EXAMPLE

```
example% cep_dist
LPC Cepstrum Distance
usage :: cep_dist filename
      cep_dist -o arguments

Defaults are as follows.
ORDER OF CEPSTRUM       : 16
ORIGINAL FILE NAME      : TMP.ORG float
REFERENCE FILE NAME     : TMP.REF float
DIFFERENCE FILE NAME    : TMP.DIS float
INFORMATION FILE NAME   : TMP.IFO ascii
example% cep_dist > temp
LPC Cepstrum Distance
usage :: cep_dist filename
```

cep_dist -o arguments

Defaults are as follows.

```
example% cat temp
ORDER OF CEPSTRUM          : 16
ORIGINAL FILE NAME         : TMP.ORG float
REFERENCE FILE NAME        : TMP.REF float
DIFFERENCE FILE NAME       : TMP.DIS float
INFORMATION FILE NAME      : TMP.IFO ascii
example% cep_dist temp
```

AUTHOR

Seiichi TENPAKU

NAME

change_amp – Change amplitude.

SYNOPSIS

change_amp *filename*
change_amp **–o** *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **change_amp**.
The *parameter*s of **change_amp** are listed below ::

MAXIMUM AMPLITUDE	: 80.0 dB
DATA TYPE	: short
INPUT FILE NAME	: TMP.DAT
OUTPUT FILE NAME	: TMP.OUT

When **change_amp** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

MAXIMUM AMPLITUDE
Sets the maximum amplitude.

DATA TYPE
Sets the type of input data. The type can be chosen from the following table:

short
float
double

If an unknown type is specified, this command can not work.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer, single-floating, or double-floating binary data. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results. The format of output data is the same as the format of input data.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% change_amp
Change amplitude.
usage :: change_amp filename
        change_amp -o arguments

Defaults are as follows.
MAXIMUM AMPLITUDE       : 80.0 dB
DATA TYPE               : short
INPUT FILE NAME         : TMP.DAT
OUTPUT FILE NAME        : TMP.OUT
example% change_amp > temp
Change amplitude.
usage :: change_amp filename
        change_amp -o arguments

Defaults are as follows.
example% cat temp
```

MAXIMUM AMPLITUDE : 80.0 dB
DATA TYPE : short
INPUT FILE NAME : TMP.DAT
OUTPUT FILE NAME : TMP.OUT
example% change_amp temp

AUTHOR

Seiichi TENPAKU

NAME

dft_bark, dft_mel – Convert the frequecny axis.

SYNOPSIS

dft_bark *filename*
dft_bark **–o** *parameter ...*

dft_mel *filename*
dft_mel **–o** *parameter ...*

DESCRIPTION

dft_bark converts the frequency axis from [Hz] sacle to [Bark] scale.
dft_mel converts the frequency axis from [Hz] sacle to [Mel] scale.

USAGE

filename contains *parameter*s, which are concerned with these commands.
The *parameter*s are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
INPUT ARRAY SIZE	: 512
OUTPUT ARRAY SIZE	: 64
INPUT DFT FILE NAME	: TMP.DFT float
OUTPUT FILE NAME	: TMP.OUT float

When the command name is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency.

INPUT ARRAY SIZE
Sets the array size of one frame of input data.

OUTPUT ARRAY SIZE
Sets the array size of one frame of output data.

INPUT DFT FILE NAME
Sets the file name of input data. The input file contains spectra data in linear frequecny sacle. The format of input data must be single-floating binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name of output data. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

dft_cep(L), dft_forward(L), fft_run(L), lpc_run(L)

EXAMPLE

example% dft_bark
Convert Array from [Hz] scale to [Bark] scale.
usage :: dft_bark filename
dft_bark -o arguments

Defaults are as follows.

SAMPLING FREQUENCY	: 20.0 kHz
INPUT ARRAY SIZE	: 512
OUTPUT ARRAY SIZE	: 64

```
INPUT DFT FILE NAME      : TMP.DFT float
OUTPUT FILE NAME         : TMP.OUT float
example% dft_bark > temp
Convert Array from [Hz] scale to [Bark] scale.
usage :: dft_bark filename
        dft_bark -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY       : 20.0 kHz
INPUT ARRAY SIZE         : 512
OUTPUT ARRAY SIZE        : 64
INPUT DFT FILE NAME      : TMP.DFT float
OUTPUT FILE NAME         : TMP.OUT float
example% dft_bark temp
```

AUTHOR

Seiichi TENPAKU

NAME

cv – convert a single-floating data file to a short integer data file.

SYNOPSIS

cv *float_file_name short_file_name*

DESCRIPTION

cv converts a a single-floating data file to a short integer data file. Single-floating data must be in a -32768 to 32767 range. Out-of-range data causes an error.

AUTHOR

Seiichi TENPAKU

NAME

dcep – Calculation of spectrogram movement.

SYNOPSIS

dcep *filename*
dcep –o *parameter* ...

DESCRIPTION

dcep calculates the delta cepstrum.

USAGE

filename contains *parameter*s, which are concerned with **dcep**.
The *parameter*s of **dcep** are listed below ::

AVERAGE PERIOD	: 5
SIZE OF ARRAY	: 17
INPUT FILE NAME	: TMP.ALP float
OUTPUT FILE NAME	: TMP.DCP float

When **dcep** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

AVERAGE PERIOD
Sets the point number for averaging.

SIZE OF ARRAY
Sets the array size of one frame data.
[1] If the input data is made using LPC analysis methods, the value of "SIZE OF ARRAY" must be set "ORDER OF LPC" + 1. For example, when the value of "ORDER OF LPC" is used 16, the value of "SIZE OF ARRAY" must be set 17.
[2] If the input data is a kind of spectra data, the value of "SIZE OF ARRAY" must be set a half of "FFT LENGTH". For example, when the value of "FFT LENGTH" is used 1024, the value of "SIZE OF ARRAY" must be set 512.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be single-floating binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

dft_cep(L), dft_forward(L), lpc_cepst(L), fft_run(L), lpc_run(L)

EXAMPLE

example% dcep
Calculation of spectrogram movement.
usage :: dcep filename
dcep -o arguments

Defaults are as follows.

AVERAGE PERIOD	: 5
SIZE OF ARRAY	: 17
INPUT FILE NAME	: TMP.ALP float
OUTPUT FILE NAME	: TMP.DCP float

example% dcep > temp
Calculation of spectrogram movement.

usage :: dcep filename
dcep -o arguments

Defaults are as follows.
example% cat temp

AVERAGE PERIOD	: 5
SIZE OF ARRAY	: 17
INPUT FILE NAME	: TMP.ALP float
OUTPUT FILE NAME	: TMP.DCP float

example% dcep temp

AUTHOR

Seiichi TENPAKU

NAME

dft_cep – Calculate the DFT cepstrum smoothed envelope.

SYNOPSIS

dft_cep *filename*
dft_cep –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **dft_cep**.
The *parameter*s of **dft_cep** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
WINDOW TYPE	: HANNING
FFT LENGTH	: 1024
FRAME PERIOD	: 5 msec
QUEFRENCY LENGTH	: 2.0 msec
INPUT FILE NAME	: TMP.DAT short
OUTPUT CEPSTRUM FILE NAME	: TMP.CEP float
OUTPUT SPECTRUM FILE NAME	: TMP.SPE float

When **dft_cep** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing function.

WINDOW TYPE
Sets the type of windowing function. The type of windowing function can be chosen from the following table:

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

If an unknown type of windowing function is specified, the type of windowing function is automatically reduced to RECTANGULAR without messages.

FFT LENGTH
Sets the number of DFT points. The value must be *2**n*, and it must be longer than "SAMPLING FREQUENCY" * "WINDOW LENGTH". There are no restrictions as to the value.

FRAME PERIOD
Sets the duration of frame period.

QUEFRENCY LENGTH
Sets the quefrency duration.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT CEPSTRUM FILE NAME
Sets the file name for the output of cepstrum data. The size of one frame is a half of "FFT LENGTH". For example, when the value of "FFT LENGTH" is set 1024, the size of one frame array is 512. The format of output data is single-floating binary.

OUTPUT SPECTRUM FILE NAME

Sets the file name for the output of spectrum data. The size of one frame is a half of "FFT LENGTH". For example, when the value of "FFT LENGTH" is set 1024, the size of one frame array is 512. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

lpc_cepst(L), lpc_run(L)

EXAMPLE

```
example% dft_cep
Calculate the DFT cepstrum smoothed envelope.
usage :: dft_cep filename
        dft_cep -o arguments

Defaults are as follows.
SAMPLING FREQUENCY          : 20.0 kHz
WINDOW LENGTH               : 30 msec
WINDOW TYPE                 : HANNING
FFT LENGTH                  : 1024
FRAME PERIOD                : 5 msec
QUEFRENCY LENGTH            : 2.0 msec
INPUT FILE NAME             : TMP.DAT short
OUTPUT CEPSTRUM FILE NAME   : TMP.CEP float
OUTPUT SPECTRUM FILE NAME   : TMP.SPE float
example% dft_cep > temp
Calculate the DFT cepstrum smoothed envelope.
usage :: dft_cep filename
        dft_cep -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY          : 20.0 kHz
WINDOW LENGTH               : 30 msec
WINDOW TYPE                 : HANNING
FFT LENGTH                  : 1024
FRAME PERIOD                : 5 msec
QUEFRENCY LENGTH            : 2.0 msec
INPUT FILE NAME             : TMP.DAT short
OUTPUT CEPSTRUM FILE NAME   : TMP.CEP float
OUTPUT SPECTRUM FILE NAME   : TMP.SPE float
example% dft_cep temp
```

AUTHOR

Seiichi TENPAKU

NAME

dft_forward – Transfer time-domain data to complex data.

SYNOPSIS

dft_forward *filename*
dft_forward –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **dft_forward**.
The *parameter*s of **dft_forward** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
WINDOW TYPE	: HANNING
FFT LENGTH	: 1024
FRAME PERIOD	: 5 msec
INPUT FILE NAME	: TMP.DAT short
SPECTROGRAM FILE NAME	: TMP.SPC float
REAL PART FILE NAME	: TMP.REAL float
IMAGINARY PART FILE NAME	: TMP.IMAG float
PHASE FILE NAME	: TMP.PHSE float

When **dft_forward** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing function.

WINDOW TYPE
Sets the type of windowing function. The type of windowing function can be chosen from the following table:

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

If an unknown type of windowing function is specified, the type of windowing function is automatically reduced to RECTANGULAR without messages.

FFT LENGTH
Sets the number of DFT points. The value must be *2**n*, and it must be longer than "SAMPLING FREQUENCY" * "WINDOW LENGTH". There are no restrictions as to the value.

FRAME PERIOD
Sets the duration of frame period.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

SPECTROGRAM FILE NAME
Sets the file name for the output of DFT running spectra.

REAL PART FILE NAME
Sets the file name for the output of real-part data.

IMAGINARY PART FILE NAME
Sets the file name for the output of imaginary-part data.

PHASE FILE NAME
Sets the file name for the output of phase data.

The size of one frame for the output data is a half of "FFT LENGTH". For example, when the value of "FFT LENGTH" is set 1024, the size of one frame array is 512. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

dft_inverse(L), fft_run(L)

EXAMPLE

```
example% dft_forward
Transfer time-domain data to complex data.
usage :: dft_forward filename
        dft_forward -o arguments

Defaults are as follows.
SAMPLING FREQUENCY          : 20.0 kHz
WINDOW LENGTH               : 30 msec
WINDOW TYPE                 : HANNING
FFT LENGTH                  : 1024
FRAME PERIOD                : 5 msec
INPUT FILE NAME             : TMP.DAT short
SPECTROGRAM FILE NAME       : TMP.SPC float
REAL PART FILE NAME         : TMP.REAL float
IMAGINARY PART FILE NAME    : TMP.IMAG float
PHASE FILE NAME             : TMP.PHSE float
example% dft_forward > temp
Transfer time-domain data to complex data.
usage :: dft_forward filename
        dft_forward -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY          : 20.0 kHz
WINDOW LENGTH               : 30 msec
WINDOW TYPE                 : HANNING
FFT LENGTH                  : 1024
FRAME PERIOD                : 5 msec
INPUT FILE NAME             : TMP.DAT short
SPECTROGRAM FILE NAME       : TMP.SPC float
REAL PART FILE NAME         : TMP.REAL float
IMAGINARY PART FILE NAME    : TMP.IMAG float
PHASE FILE NAME             : TMP.PHSE float
example% dft_forward temp
```

AUTHOR

Seiichi TENPAKU

NAME

dft_inverse – Transfer complex data to time-domain data

SYNOPSIS

dft_inverse *filename*
dft_inverse –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **dft_inverse**.
The *parameter*s of **dft_inverse** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
WINDOW TYPE	: HANNING
FFT LENGTH	: 1024
FRAME PERIOD	: 5 msec
REAL PART FILE NAME	: TMP.REAL float
IMAGINARY PART FILE NAME	: TMP.IMAG float
OUTPUT FILE NAME	: TMP.OUT short

When **dft_inverse** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing function.

WINDOW TYPE
Sets the type of windowing function. The type of windowing function can be chosen from the following table:

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

If an unknown type of windowing function is specified, the type of windowing function is automatically reduced to RECTANGULAR without messages.

FFT LENGTH
Sets the number of DFT points. The value must be *2**n*, and it must be longer than "SAMPLING FREQUENCY" * "WINDOW LENGTH". There are no restrictions as to the value.

FRAME PERIOD
Sets the duration of frame period.

REAL PART FILE NAME
Sets the file name for the input of real-part data.

IMAGINARY PART FILE NAME
Sets the file name for the input of imaginary-part data.

OUTPUT FILE NAME
Sets the file name for the output of results. The format of output data is short integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/~/', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

dft_forward(L)

EXAMPLE

```
example% dft_inverse
Transfer complex data to time-domain data
usage :: dft_inverse filename
        dft_inverse -o arguments

Defaults are as follows.
SAMPLING FREQUENCY              : 20.0 kHz
WINDOW LENGTH                   : 30 msec
WINDOW TYPE                     : HANNING
FFT LENGTH                      : 1024
FRAME PERIOD                    : 5 msec
REAL PART FILE NAME             : TMP.REAL float
IMAGINARY PART FILE NAME        : TMP.IMAG float
OUTPUT FILE NAME                : TMP.OUT short
example% dft_inverse > temp
Transfer complex data to time-domain data
usage :: dft_inverse filename
        dft_inverse -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY              : 20.0 kHz
WINDOW LENGTH                   : 30 msec
WINDOW TYPE                     : HANNING
FFT LENGTH                      : 1024
FRAME PERIOD                    : 5 msec
REAL PART FILE NAME             : TMP.REAL float
IMAGINARY PART FILE NAME        : TMP.IMAG float
OUTPUT FILE NAME                : TMP.OUT short
example% dft_inverse temp
```

AUTHOR

Seiichi TENPAKU

NAME

differential, integral – Infinitesimal calculus.

SYNOPSIS

differential *filename*
differential –o *parameter ...*

integral *filename*
integral –o *parameter ...*

DESCRIPTION

differential makes a differential calculation.
integral makes an integral calculation.

USAGE

filename contains *parameters*, which are concerned with these commands.
The *parameters* are listed below ::

ORDER	: 1
INPUT FILE NAME	: TMP.ORG float
OUTPUT FILE NAME	: TMP.OUT float

When the command name is entered without any arguments, the command diplays the *parameters* and default settings on the standard output.

PARAMETERS

ORDER
Sets the differential/integral order.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be single-floating binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% differential
Differential calculation.
usage :: differential filename
        differential -o arguments

Defaults are as follows.
ORDER                   : 1
INPUT FILE NAME         : TMP.ORG float
OUTPUT FILE NAME        : TMP.OUT float
example% differential > temp
Differential calculation.
usage :: differential filename
        differential -o arguments

Defaults are as follows.
example% cat temp
ORDER                   : 1
INPUT FILE NAME         : TMP.ORG float
OUTPUT FILE NAME        : TMP.OUT float
```

example% differential temp

AUTHOR

Seiichi TENPAKU

NAME

emphasis – Self differential filtering.

SYNOPSIS

emphasis *filename*
emphasis –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **emphasis.**
The *parameter*s of **emphasis** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
PREEMPAHSIS	: 0.98
INPUT FILE NAME	: TMP.DAT short
OUTPUT FILE NAME	: TMP.OUT short

When **emphasis** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

PREEMPAHSIS
Sets the pre-emphasis factor. The range of this value is 0.0 to 1.0.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results. The format of output data is short integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

hpf1(L), lpf1(L), syn_pole(L), syn_zero(L)

EXAMPLE

```
example% emphasis
Self differential filtering.
usage :: emphasis filename
        emphasis -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
PREEMPAHSIS             : 0.98
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.OUT short
example% emphasis > temp
Self differential filtering.
usage :: emphasis filename
        emphasis -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
PREEMPAHSIS             : 0.98
INPUT FILE NAME         : TMP.DAT short
```

OUTPUT FILE NAME : TMP.OUT short
example% emphasis temp

AUTHOR

Seiichi TENPAKU

NAME

euclid_dist – Calculate Euclid distance.

SYNOPSIS

euclid_dist *filename*
euclid_dist –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **euclid_dist**.
The *parameter*s of **euclid_dist** are listed below ::

SIZE OF ARRAY	: 64
ORIGINAL FILE NAME	: TMP.ORG float
REFERENCE FILE NAME	: TMP.REF float
DIFFERENCE FILE NAME	: TMP.DIS float
INFORMATION FILE NAME	: TMP.IFO ascii

When **euclid_dist** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SIZE OF ARRAY
Sets the array size of one frame data.

ORIGINAL FILE NAME
Sets the file name of input original data. The format of input data must be single-floating binary.

REFERENCE FILE NAME
Sets the file name of input refference data. The format of input data must be single-floating binary.

DIFFERENCE FILE NAME
Sets the file name of output differences in each frame. The format of input data is single-floating binary.

INFORMATION FILE NAME
Sets the file name for output of results.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/'/', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

cep_dist(L), dtw_dist(L), spc_dist(L)

EXAMPLE

```
example% euclid_dist
Calculate Euclid distance.
usage :: euclid_dist filename
        euclid_dist -o arguments

Defaults are as follows.
SIZE OF ARRAY               : 64
ORIGINAL FILE NAME          : TMP.ORG float
REFERENCE FILE NAME         : TMP.REF float
DIFFERENCE FILE NAME        : TMP.DIS float
INFORMATION FILE NAME       : TMP.IFO ascii
example% euclid_dist > temp
Calculate Euclid distance.
usage :: euclid_dist filename
        euclid_dist -o arguments
```

Defaults are as follows.

```
example% cat temp
SIZE OF ARRAY                : 64
ORIGINAL FILE NAME           : TMP.ORG float
REFERENCE FILE NAME          : TMP.REF float
DIFFERENCE FILE NAME         : TMP.DIS float
INFORMATION FILE NAME        : TMP.IFO ascii
example% euclid_dist temp
```

AUTHOR

Seiichi TENPAKU

NAME

fft_run – Calculate the DFT running spectra.

SYNOPSIS

fft_run *filename*
fft_run **–o** *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **fft_run**.
The *parameter*s of **fft_run** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
WINDOW TYPE	: HANNING
FFT LENGTH	: 1024
FRAME PERIOD	: 5 msec
PREEMPAHSIS	: 0.98
INPUT FILE NAME	: TMP.DAT short
OUTPUT FILE NAME	: TMP.DFT float

When **fft_run** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY

Sets the sampling frequency of input data.

WINDOW LENGTH

Sets the duration of windowing function.

WINDOW TYPE

Sets the type of windowing function. The type of windowing function can be chosen from the following table:

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

If an unknown type of windowing function is specified, the type of windowing function is automatically reduced to RECTANGULAR without messages.

FFT LENGTH

Sets the number of DFT points. The value must be *2**n*, and it must be longer than "SAMPLING FREQUENCY" * "WINDOW LENGTH". There are no restrictions as to the value.

FRAME PERIOD

Sets the duration of frame period.

PREEMPAHSIS

Sets the pre-emphasis factor. The range of this value is 0.0 to 1.0.

INPUT FILE NAME

Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT FILE NAME

Sets the file name for the output of DFT running spectra. The size of one frame is a half of "FFT LENGTH". For example, when the value of "FFT LENGTH" is set 1024, the size of one frame array is 512. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

dft_forward(L)

EXAMPLE

```
example% fft_run
Calculate the DFT running spectra.
usage :: fft_run filename
        fft_run -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
WINDOW TYPE             : HANNING
FFT LENGTH              : 1024
FRAME PERIOD            : 5 msec
PREEMPAHSIS             : 0.98
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.DFT float
example% fft_run > temp
Calculate the DFT running spectra.
usage :: fft_run filename
        fft_run -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
WINDOW TYPE             : HANNING
FFT LENGTH              : 1024
FRAME PERIOD            : 5 msec
PREEMPAHSIS             : 0.98
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.DFT float
example% fft_run temp
```

AUTHOR

Seiichi TENPAKU

NAME

fileshuffle – Shuffle file lists.

SYNOPSIS

fileshuffle *filename*
fileshuffle –o *parameter ...*

DESCRIPTION

fileshuffle randomly arranges lists.

USAGE

filename contains *parameter*s, which are concerned with **fileshuffle.**
The *parameter*s of **fileshuffle** are listed below ::

SEED OF RANDOMIZATION	: 17
NUMBER OF REPEAT	: 1
INPUT FILE NAME	: TMP.DAT ascii
OUTPUT FILE NAME	: TMP.OUT ascii
TEMPLATE FILE NAME	: TMP.LST ascii

When **fileshuffle** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SEED OF RANDOMIZATION
Sets a random seed.

NUMBER OF REPEAT
Sets a repeat number.

INPUT FILE NAME
Sets the file name of input lists.

OUTPUT FILE NAME
Sets the file name for the output of results.

TEMPLATE FILE NAME
Sets the file name for the output of template.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% fileshuffle
Shuffle file lists.
usage :: fileshuffle filename
        fileshuffle -o arguments

Defaults are as follows.
SEED OF RANDOMIZATION    : 17
NUMBER OF REPEAT         : 1
INPUT FILE NAME          : TMP.DAT ascii
OUTPUT FILE NAME         : TMP.OUT ascii
TEMPLATE FILE NAME       : TMP.LST ascii
example% cat TMP.DAT
a
b
c
d
e
f
```

```
example% fileshuffle -o "SEED OF RANDOMIZATION   : 100"
example% cat TMP.OUT
b
a
c
f
d
e
example% cat TMP.LST
2
1
3
6
4
5
```

AUTHOR

Seiichi TENPAKU

NAME

find_zerocrs – Find the zero crossing points.

SYNOPSIS

find_zerocrs *filename*
find_zerocrs **–o** *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **find_zerocrs**.
The *parameter*s of **find_zerocrs** are listed below ::

```
INPUT FILE NAME        : TMP.DAT short
OUTPUT FILE NAME       : TMP.OUT int
```

When **find_zerocrs** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

INPUT FILE NAME

Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT FILE NAME

Sets the file name for the output of results. The format of output data is integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

zerocrs(L)

EXAMPLE

```
example% find_zerocrs
Find the zero crossing points.
usage :: find_zerocrs filename
        find_zerocrs -o arguments

Defaults are as follows.
INPUT FILE NAME        : TMP.DAT short
OUTPUT FILE NAME       : TMP.OUT int
example% find_zerocrs > temp
Find the zero crossing points.
usage :: find_zerocrs filename
        find_zerocrs -o arguments

Defaults are as follows.
example% cat temp
INPUT FILE NAME        : TMP.DAT short
OUTPUT FILE NAME       : TMP.OUT int
example% find_zerocrs temp
```

AUTHOR

Seiichi TENPAKU

NAME

ftrack – Formant Tracking by LPC method.

SYNOPSIS

ftrack *filename*
ftrack –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **ftrack**.
The *parameter*s of **ftrack** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
WINDOW TYPE	: HANNING
FRAME PERIOD	: 5 msec
PREEMPAHSIS	: 0.98
ORDER OF LPC	: 16
INPUT FILE NAME	: TMP.DAT short
FREQUENCY FILE NAME	: TMP.FRQ float
BANDWIDTH FILE NAME	: TMP.BND float

When **ftrack** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing function.

WINDOW TYPE
Sets the type of windowing function. The type of windowing function can be chosen from the following table:

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

If an unknown type of windowing function is specified, the type of windowing function is automatically reduced to RECTANGULAR without messages.

FRAME PERIOD
Sets the duration of frame period.

PREEMPAHSIS
Sets the pre-emphasis factor. The range of this value is 0.0 to 1.0.

ORDER OF LPC
Sets the order of LPC (Linear Prediction Coefficients). There are no restrictions as to the value.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

FREQUENCY FILE NAME
Sets the file name for the output of formant frequency data. The size of one frame is a half of "ORDER OF LPC". For example, when the value of "ORDER OF LPC" is set 16, the size of one frame array is 8. The format of output data is single-floating binary.

BANDWIDTH FILE NAME

Sets the file name for the output of formant bandwidth data. The size of one frame is a half of "ORDER OF LPC". For example, when the value of "ORDER OF LPC" is set 16, the size of one frame array is 8. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

peak_pick(L)

EXAMPLE

```
example% ftrack
Formant Tracking by LPC method.
usage :: ftrack filename
        ftrack -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
WINDOW TYPE             : HANNING
FRAME PERIOD            : 5 msec
PREEMPAHSIS             : 0.98
ORDER OF LPC            : 16
INPUT FILE NAME         : TMP.DAT short
FREQUENCY FILE NAME     : TMP.FRQ float
BANDWIDTH FILE NAME     : TMP.BND float
example% ftrack > temp
Formant Tracking by LPC method.
usage :: ftrack filename
        ftrack -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
WINDOW TYPE             : HANNING
FRAME PERIOD            : 5 msec
PREEMPAHSIS             : 0.98
ORDER OF LPC            : 16
INPUT FILE NAME         : TMP.DAT short
FREQUENCY FILE NAME     : TMP.FRQ float
BANDWIDTH FILE NAME     : TMP.BND float
example% ftrack temp
```

AUTHOR

Seiichi TENPAKU

NAME

rect_wave, saw_wave, sine_wave, tri_wave – Generating a signal waveform.

SYNOPSIS

rect_wave *filename*
rect_wave **–o** *parameter ...*

saw_wave *filename*
saw_wave **–o** *parameter ...*

sine_wave *filename*
sine_wave **–o** *parameter ...*

tri_wave *filename*
tri_wave **–o** *parameter ...*

DESCRIPTION

rect_wave generates a rectangular waveform.
saw_wave generates a saw waveform.
sine_wave generates a sine waveform.
tri_wave generates a tritangular waveform.

USAGE

filename contains *parameters*, which are concerned with these commands.
The *parameters* are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
START FREQ.	: 1000 Hz
END FREQ.	: 1000 Hz
AMPLITUDE	: 20000
DC BIAS	: 0
DATA LENGTH	: 200 msec
SIGNAL LENGTH	: 100 msec
OFFSET TIME	: 50 msec
RISE ENVELOPE	: 10 msec
FALL ENVELOPE	: 10 msec
OUTPUT FILE NAME	: TMP.SIG short

When the command name is entered without any arguments, the commands diplay the *parameters* and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency.

START FREQ.
Sets the start frequency.

END FREQ.
Sets the end frequency.

When the value of "START FREQ." is equal to the value of "END FREQ.", the generating frequency is constant. On the other hand, when the value of "START FREQ." is not equal to the value of "END FREQ.", the generating frequency is moved from the value of "START FREQ." to the value of "END FREQ.".

AMPLITUDE
Sets the amplitude. The rane of the amplitude is 1 to 32767.

DC BIAS
Sets the DC bias. If the value of "DC BIAS" is 0, there are no effects on DC.

DATA LENGTH
Sets the duration of whole data.

SIGNAL LENGTH
Sets the duration of just generating signal. The value of "SIGNAL LENGTH" must be less than the value of "DATA LENGTH".

OFFSET TIME
Sets the offset time of generating signal. The value of "OFFSET TIME" must be less than the value of subtract "DATA LENGTH" from "SIGNAL LENGTH".

RISE ENVELOPE
Sets the duration of rising envelope. The value of "RISE ENVELOPE" must be less than the value of "SIGNAL LENGTH".

FALL ENVELOPE
Sets the duration of falling envelope. The value of "FALL ENVELOPE" must be less than the value of "SIGNAL LENGTH".

OUTPUT FILE NAME
Sets the file name for storing data. The format of output data is short integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/~/', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

noise_wave(L)

EXAMPLE

```
example% sine_wave
Generating a sine wave.
usage :: sine_wave filename
        sine_wave -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
START FREQ.             : 1000 Hz
END FREQ.               : 1000 Hz
AMPLITUDE               : 20000
DC BIAS                 : 0
DATA LENGTH             : 200 msec
SIGNAL LENGTH           : 100 msec
OFFSET TIME             : 50 msec
RISE ENVELOPE           : 10 msec
FALL ENVELOPE           : 10 msec
OUTPUT FILE NAME        : TMP.SIG short
example% sine_wave > temp
Generating a sine wave.
usage :: sine_wave filename
        sine_wave -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
START FREQ.             : 1000 Hz
```

END FREQ. : 1000 Hz
AMPLITUDE : 20000
DC BIAS : 0
DATA LENGTH : 200 msec
SIGNAL LENGTH : 100 msec
OFFSET TIME : 50 msec
RISE ENVELOPE : 10 msec
FALL ENVELOPE : 10 msec
OUTPUT FILE NAME : TMP.SIG short
example% sine_wave temp

AUTHOR

Seiichi TENPAKU

NAME

hpf1, lpf1 – 1st order IIR filter.

SYNOPSIS

hpf1 *filename*
hpf1 **–o** *parameter* ...

lpf1 *filename*
lpf1 **–o** *parameter* ...

DESCRIPTION

hpf1 is a 1st order IIR high-pass filter.
lpf1 is a 1st order IIR low-pass filter.

USAGE

filename contains *parameter*s, which are concerned with **hpf1** and **lpf1.**
The *parameter*s are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
CUT OFF FREQUENCY	: 100.0 Hz
INPUT FILE NAME	: TMP.DAT short
OUTPUT FILE NAME	: TMP.OUT short

When the command name is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

CUT OFF FREQUENCY
Sets the cut off frequency. The upper limit of the cut off frequency is a quarter of the sampling frequency. For example, when the sampling frequency 20 [kHz], the upper limit of the cut off frequency is 5000 [Hz].

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results. The format of output data is short integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

differ(L), syn_pole(L), syn_zero(L)

EXAMPLE

```
example% hpf1
IIR high-pass filter.
usage :: hpf1 filename
        hpf1 -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
CUT OFF FREQUENCY       : 100.0 Hz
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.OUT short
example% hpf1 > temp
IIR high-pass filter.
```

usage :: hpf1 filename
hpf1 -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY : 20.0 kHz
CUT OFF FREQUENCY : 100.0 Hz
INPUT FILE NAME : TMP.DAT short
OUTPUT FILE NAME : TMP.OUT short
example% hpf1 temp

AUTHOR

Seiichi TENPAKU

NAME

lpc_cepst – Calculate LPC CEPSTRUM.

SYNOPSIS

lpc_cepst *filename*
lpc_cepst –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **lpc_cepst**.
The *parameter*s of **lpc_cepst** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
WINDOW TYPE	: HANNING
FRAME PERIOD	: 5 msec
PREEMPAHSIS	: 0.98
ORDER OF LPC	: 16
ORDER OF CEPSTRUM	: 16
INPUT FILE NAME	: TMP.DAT short
OUTPUT CEPSTRUM FILE NAME	: TMP.CEP float
OUTPUT ALPHA FILE NAME	: TMP.ALP float

When **lpc_cepst** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing function.

WINDOW TYPE
Sets the type of windowing function. The type of windowing function can be chosen from the following table:

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

If an unknown type of windowing function is specified, the type of windowing function is automatically reduced to RECTANGULAR without messages.

FRAME PERIOD
Sets the duration of frame period.

PREEMPAHSIS
Sets the pre-emphasis factor. The range of this value is 0.0 to 1.0.

ORDER OF LPC
Sets the order of LPC (Linear Prediction Coefficients). There are no restrictions as to the value.

ORDER OF CEPSTRUM
Sets the order of cepstrum coefficients. There are no restrictions as to the value.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT CEPSTRUM FILE NAME
Sets the file name for the output of cepstrum coefficients. The size of one frame is "ORDER OF CEPSTRUM" + 1. For example, when the value of "ORDER OF CEPSTRUM" is set 16, the size of one frame array is 17. The format of output data is single-floating binary.

OUTPUT ALPHA FILE NAME
Sets the file name for the output of alpha-parameters. The size of one frame is "ORDER OF LPC" + 1. For example, when the value of "ORDER OF LPC" is set 16, the size of one frame array is 17. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

cep_dist(L)

EXAMPLE

```
example% lpc_cepst
Calculate LPC CEPSTRUM.
usage :: lpc_cepst filename
        lpc_cepst -o arguments

Defaults are as follows.
SAMPLING FREQUENCY          : 20.0 kHz
WINDOW LENGTH               : 30 msec
WINDOW TYPE                 : HANNING
FRAME PERIOD                : 5 msec
PREEMPAHSIS                 : 0.98
ORDER OF LPC                : 16
ORDER OF CEPSTRUM           : 16
INPUT FILE NAME             : TMP.DAT short
OUTPUT CEPSTRUM FILE NAME   : TMP.CEP float
OUTPUT ALPHA FILE NAME      : TMP.ALP float
example% lpc_cepst > temp
Calculate LPC CEPSTRUM.
usage :: lpc_cepst filename
        lpc_cepst -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY          : 20.0 kHz
WINDOW LENGTH               : 30 msec
WINDOW TYPE                 : HANNING
FRAME PERIOD                : 5 msec
PREEMPAHSIS                 : 0.98
ORDER OF LPC                : 16
ORDER OF CEPSTRUM           : 16
INPUT FILE NAME             : TMP.DAT short
OUTPUT CEPSTRUM FILE NAME   : TMP.CEP float
OUTPUT ALPHA FILE NAME      : TMP.ALP float
example% lpc_cepst temp
```

AUTHOR

Seiichi TENPAKU

NAME

lpc_run – Calculate LPC running spectra.

SYNOPSIS

lpc_run *filename*
lpc_run –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **lpc_run**.
The *parameter*s of **lpc_run** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
WINDOW TYPE	: HANNING
FFT LENGTH	: 1024
FRAME PERIOD	: 5 msec
PREEMPAHSIS	: 0.98
ORDER OF LPC	: 16
INPUT FILE NAME	: TMP.DAT short
OUTPUT LPC FILE NAME	: TMP.LPC float
OUTPUT ALPHA FILE NAME	: TMP.ALP float

When **lpc_run** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing function.

WINDOW TYPE
Sets the type of windowing function. The type of windowing function can be chosen from the following table:

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

If an unknown type of windowing function is specified, the type of windowing function is automatically reduced to RECTANGULAR without messages.

FFT LENGTH
Sets the number of DFT points. The value must be *2**n*, and it must be longer than "SAMPLING FREQUENCY" * "WINDOW LENGTH". There are no restrictions as to the value.

FRAME PERIOD
Sets the duration of frame period.

PREEMPAHSIS
Sets the pre-emphasis factor. The range of this value is 0.0 to 1.0.

ORDER OF LPC
Sets the order of LPC (Linear Prediction Coefficients). There are no restrictions as to the value.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT LPC FILE NAME
Sets the file name for the output of LPC running spectra. The size of one frame is a half of "FFT LENGTH". For example, when the value of "FFT LENGTH" is set 1024, the size of one frame array is 512. The format of output data is single-floating binary.

OUTPUT ALPHA FILE NAME
Sets the file name for the output of alpha-parameters. The size of one frame is "ORDER OF LPC" + 1. For example, when the value of "ORDER OF LPC" is set 16, the size of one frame array is 17. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

dcep(L), ftrack(L), lpc_cepst(L), parcor(L), peak_pick(L)

EXAMPLE

```
example% lpc_run
Calculate LPC running spectra.
usage :: lpc_run filename
        lpc_run -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
WINDOW TYPE             : HANNING
FFT LENGTH              : 1024
FRAME PERIOD            : 5 msec
PREEMPAHSIS             : 0.98
ORDER OF LPC            : 16
INPUT FILE NAME         : TMP.DAT short
OUTPUT LPC FILE NAME    : TMP.LPC float
OUTPUT ALPHA FILE NAME  : TMP.ALP float
example% lpc_run > temp
Calculate LPC running spectra.
usage :: lpc_run filename
        lpc_run -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
WINDOW TYPE             : HANNING
FFT LENGTH              : 1024
FRAME PERIOD            : 5 msec
PREEMPAHSIS             : 0.98
ORDER OF LPC            : 16
INPUT FILE NAME         : TMP.DAT short
OUTPUT LPC FILE NAME    : TMP.LPC float
OUTPUT ALPHA FILE NAME  : TMP.ALP float
example% lpc_run temp
```

AUTHOR

Seiichi TENPAKU

NAME

lstsq_smooth – Smoothing by least square method.

SYNOPSIS

lstsq_smooth *filename*
lstsq_smooth –o *parameter* ...

USAGE

filename contains *parameter*s, which are concerned with **lstsq_smooth**.
The *parameter*s of **lstsq_smooth** are listed below ::

```
SMOOTHING POINTS              : 200
POLYNOMIAL ORDER ( <= 20 )    : 10
INPUT FILE NAME               : TMP.ORG float
OUTPUT FILE NAME              : TMP.OUT float
```

When **lstsq_smooth** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SMOOTHING POINTS
Sets the smoothing points.

POLYNOMIAL ORDER (<= 20)
Sets the polynomial order. The value must be less than 20.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be single-floating binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% lstsq_smooth
Smoothing by least square method.
usage :: lstsq_smooth filename
         lstsq_smooth -o arguments

Defaults are as follows.
SMOOTHING POINTS              : 200
POLYNOMIAL ORDER ( <= 20 )    : 10
INPUT FILE NAME               : TMP.ORG float
OUTPUT FILE NAME              : TMP.OUT float
example% lstsq_smooth > temp
Smoothing by least square method.
usage :: lstsq_smooth filename
         lstsq_smooth -o arguments

Defaults are as follows.
example% cat temp
SMOOTHING POINTS              : 200
POLYNOMIAL ORDER ( <= 20 )    : 10
INPUT FILE NAME               : TMP.ORG float
OUTPUT FILE NAME              : TMP.OUT float
example% lstsq_smooth temp
```

AUTHOR

Seiichi TENPAKU

NAME

make_pair – Making Pairs.

SYNOPSIS

make_pair *filename*
make_pair –o *parameter ...*

DESCRIPTION

make_pair makes paired-lists.

USAGE

filename contains *parameter*s, which are concerned with **make_pair**.
The *parameter*s of **make_pair** are listed below ::

INPUT LIST FILE NAME : TMP.LST ascii
OUTPUT LIST FILE NAME : TMP.TBL ascii

When **make_pair** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

INPUT LIST FILE NAME
Sets the file name of input lists.

OUTPUT LIST FILE NAME
Sets the file name of output lists.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% make_pair
Making Pairs.
usage :: make_pair filename
        make_pair -o arguments

Defaults are as follows.
INPUT LIST FILE NAME        : TMP.LST ascii
OUTPUT LIST FILE NAME       : TMP.TBL ascii
example% make_pair > temp
Making Pairs.
usage :: make_pair filename
        make_pair -o arguments

Defaults are as follows.
example% cat TMP.LST
a
b
c
example% make_pair temp
example% cat TMP.TBL
a       b
a       c
b       a
b       c
c       a
c       b
```

AUTHOR

Seiichi TENPAKU

NAME

median_smooth – Median Smoothing.

SYNOPSIS

median_smooth *filename*
median_smooth –o *parameter* ...

USAGE

filename contains *parameters*, which are concerned with **median_smooth**.
The *parameters* of **median_smooth** are listed below ::

```
MEDIAN BLOCK NUMBER     : 5
INPUT FILE NAME         : TMP.DAT float
OUTPUT FILE NAME        : TMP.OUT float
```

When **median_smooth** is entered without any arguments, the command diplays the *parameters* and default settings on the standard output.

PARAMETERS

MEDIAN BLOCK NUMBER
Sets the block number.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be single-floating binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% median_smooth
Median Smoothing.
usage :: median_smooth filename
       median_smooth -o arguments

Defaults are as follows.
MEDIAN BLOCK NUMBER     : 5
INPUT FILE NAME         : TMP.DAT float
OUTPUT FILE NAME        : TMP.OUT float
example% bcat TMP.DAT
0.000000
1.000000
2.000000
0.000000
1.000000
2.000000
0.000000
1.000000
2.000000
0.000000
example% median_smooth -o "MEDIAN BLOCK NUMBER : 3"
!10
example% bcat TMP.OUT
0.000000
1.000000
1.000000
```

```
1.000000
1.000000
1.000000
1.000000
1.000000
1.000000
0.000000
```

SEE ALSO

bcat(L)

AUTHOR

Seiichi TENPAKU

NAME

merge – merge ascii streams

SYNOPSIS

merge *files* ...

DESCRIPTION

merge merges ascii data colums side-by-side and displays the results on the standard output.

SEE ALSO

separate(L)

EXAMPLE

```
example% cat A
a       1
b       2
c       3
example% cat B
2
4
6
example% merge A B
a       1       2
b       2       4
c       3       6
```

AUTHOR

Seiichi TENPAKU

NAME

noise_wave – Generating a band noise.

SYNOPSIS

noise_wave *filename*
noise_wave –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **noise_wave**.
The *parameter*s of **noise_wave** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
START FREQUENCY	: 1000 Hz
END FREQUENCY	: 1000 Hz
STEP FREQUENCY	: 10 Hz
AMPLITUDE	: 20000
DC BIAS	: 0
DATA LENGTH	: 200 msec
SIGNAL LENGTH	: 100 msec
OFFSET TIME	: 50 msec
RISE ENVELOPE	: 10 msec
FALL ENVELOPE	: 10 msec
NOISE SEED	: 100
OUTPUT FILE NAME	: TMP.SIG short

When **noise_wave** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency.

START FREQUENCY
Sets the start frequency.

END FREQUENCY
Sets the end frequency.

STEP FREQUENCY
Sets the step frequency.

When the value of "START FREQUENCY" is equal to the value of "END FREQUENCY", the generating frequency is constant. On the other hand, when the value of "START FREQUENCY" is not equal to the value of "END FREQUENCY", the generating frequency is stepped from the value of "START FREQUENCY" to the value of "END FREQUENCY" at the value of "STEP FREQUENCY".

AMPLITUDE
Sets the amplitude. The rane of the amplitude is 1 to 32767.

DC BIAS
Sets the DC bias. If the value of "DC BIAS" is 0, there are no effects on DC.

DATA LENGTH
Sets the duration of whole data.

SIGNAL LENGTH
Sets the duration of just generating signal. The value of "SIGNAL LENGTH" must be less than the value of "DATA LENGTH".

OFFSET TIME
Sets the offset time of generating signal. The value of "OFFSET TIME" must be less than the value of subtract "DATA LENGTH" from "SIGNAL LENGTH".

RISE ENVELOPE
Sets the duration of rising envelope. The value of "RISE ENVELOPE" must be less than the value of "SIGNAL LENGTH".

FALL ENVELOPE
Sets the duration of falling envelope. The value of "FALL ENVELOPE" must be less than the value of "SIGNAL LENGTH".

NOISE SEED
Sets the ranodom seed. If the value of "NOISE SEED" is equal to 0, In each frequency, the phases of waveform are started at 0.

OUTPUT FILE NAME
Sets the file name for storing data. The format of output data is short integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/~/', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

rect_wave(L), saw_wave(L), sine_wave(L), tri_wave(L)

EXAMPLE

```
example% noise_wave
Generating a band noise.
usage :: noise_wave filename
        noise_wave -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
START FREQUENCY         : 1000 Hz
END FREQUENCY           : 1000 Hz
STEP FREQUENCY          : 10 Hz
AMPLITUDE               : 20000
DC BIAS                 : 0
DATA LENGTH             : 200 msec
SIGNAL LENGTH           : 100 msec
OFFSET TIME             : 50 msec
RISE ENVELOPE           : 10 msec
FALL ENVELOPE           : 10 msec
NOISE SEED              : 100
OUTPUT FILE NAME        : TMP.SIG short
example% noise_wave > temp
Generating a band noise.
usage :: noise_wave filename
        noise_wave -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
START FREQUENCY         : 1000 Hz
END FREQUENCY           : 1000 Hz
STEP FREQUENCY          : 10 Hz
AMPLITUDE               : 20000
DC BIAS                 : 0
DATA LENGTH             : 200 msec
SIGNAL LENGTH           : 100 msec
```

OFFSET TIME : 50 msec
RISE ENVELOPE : 10 msec
FALL ENVELOPE : 10 msec
NOISE SEED : 100
OUTPUT FILE NAME : TMP.SIG short
example% noise_wave temp

AUTHOR

Seiichi TENPAKU

NAME

parcor – Calculate PARCOR parameters.

SYNOPSIS

parcor *filename*
parcor –o *parameter* ...

USAGE

filename contains *parameter*s, which are concerned with **parcor**.
The *parameter*s of **parcor** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
WINDOW TYPE	: HANNING
FRAME PERIOD	: 5 msec
PREEMPAHSIS	: 0.98
ORDER OF LPC	: 16
INPUT FILE NAME	: TMP.DAT short
ALPHA FILE NAME	: TMP.ALP float
PARCOR FILE NAME	: TMP.PAR float
RESID FILE NAME	: TMP.RES float

When **parcor** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing function.

WINDOW TYPE
Sets the type of windowing function. The type of windowing function can be chosen from the following table:

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

If an unknown type of windowing function is specified, the type of windowing function is automatically reduced to RECTANGULAR without messages.

FRAME PERIOD
Sets the duration of frame period.

PREEMPAHSIS
Sets the pre-emphasis factor. The range of this value is 0.0 to 1.0.

ORDER OF LPC
Sets the order of LPC (Linear Prediction Coefficients). There are no restrictions as to the value.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT ALPHA FILE NAME
Sets the file name for the output of alpha-parameters. The size of one frame is "ORDER OF LPC" + 1. For example, when the value of "ORDER OF LPC" is set 16, the size of one frame array is 17. The format of output data is single-floating binary.

OUTPUT PARCOR FILE NAME
Sets the file name for the output of alpha-parameters. The size of one frame is "ORDER OF LPC" + 1. For example, when the value of "ORDER OF LPC" is set 16, the size of one frame array is 17. The format of output data is single-floating binary.

OUTPUT RESID FILE NAME
Sets the file name for the output of residual. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% parcor
Calculate PARCOR parameters.
usage :: parcor filename
        parcor -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
WINDOW TYPE             : HANNING
FRAME PERIOD            : 5 msec
PREEMPAHSIS             : 0.98
ORDER OF LPC            : 16
INPUT FILE NAME         : TMP.DAT short
ALPHA FILE NAME         : TMP.ALP float
PARCOR FILE NAME        : TMP.PAR float
RESID FILE NAME         : TMP.RES float
example% parcor > temp
Calculate PARCOR parameters.
usage :: parcor filename
        parcor -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
WINDOW TYPE             : HANNING
FRAME PERIOD            : 5 msec
PREEMPAHSIS             : 0.98
ORDER OF LPC            : 16
INPUT FILE NAME         : TMP.DAT short
ALPHA FILE NAME         : TMP.ALP float
PARCOR FILE NAME        : TMP.PAR float
RESID FILE NAME         : TMP.RES float
example% parcor temp
```

AUTHOR

Seiichi TENPAKU

NAME

peak_pick – Peak-Picking for formants.

SYNOPSIS

peak_pick *filename*
peak_pick –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **peak_pick**.
The *parameter*s of **peak_pick** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
ARRAY SIZE	: 512
NUMBER OF PEAK	: 5
INVERSION OPTION	: OFF
AUTO REGRESSIVE FUNCTION	: ON
INPUT FILE NAME	: TMP.SPC float
FREQUENCY FILE NAME	: TMP.FRQ float
BANDWIDTH FILE NAME	: TMP.BND float
AMPLITUDE FILE NAME	: TMP.AMP float

When **peak_pick** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency.

ARRAY SIZE
Sets the one frame size of input data.

NUMBER OF PEAK
Sets the peak-picking number.

INVERSION OPTION
Sets the inversion option. When the value is "ON", the input data will be inversed.

AUTO REGRESSIVE FUNCTION
Sets the auto-regressive function. When the value is "ON", the input data will be applied the auto-regressive function.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be single-floating binary. There are no restrictions as to the file length.

FREQUENCY FILE NAME
Sets the file name for the output of formant frequency data. The size of one frame is equal to the value of "NUMBER OF PEAK". The format of output data is single-floating binary.

BANDWIDTH FILE NAME
Sets the file name for the output of formant bandwidth data. The size of one frame is equal to the value of "NUMBER OF PEAK". The format of output data is single-floating binary.

AMPLITUDE FILE NAME
Sets the file name for the output of formant peak amplitude data. The size of one frame is equal to the value of "NUMBER OF PEAK". The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

ftrack(L)

EXAMPLE

```
example% peak_pick
Peak-Picking for formants.
usage :: peak_pick filename
        peak_pick -o arguments

Defaults are as follows.
SAMPLING FREQUENCY          : 20.0 kHz
ARRAY SIZE                  : 512
NUMBER OF PEAK              : 5
INVERSION OPTION            : OFF
AUTO REGRESSIVE FUNCTION    : ON
INPUT FILE NAME             : TMP.SPC float
FREQUENCY FILE NAME         : TMP.FRQ float
BANDWIDTH FILE NAME         : TMP.BND float
AMPLITUDE FILE NAME         : TMP.AMP float
example% peak_pick > temp
Peak-Picking for formants.
usage :: peak_pick filename
        peak_pick -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY          : 20.0 kHz
ARRAY SIZE                  : 512
NUMBER OF PEAK              : 5
INVERSION OPTION            : OFF
AUTO REGRESSIVE FUNCTION    : ON
INPUT FILE NAME             : TMP.SPC float
FREQUENCY FILE NAME         : TMP.FRQ float
BANDWIDTH FILE NAME         : TMP.BND float
AMPLITUDE FILE NAME         : TMP.AMP float
example% peak_pick temp
```

AUTHOR

Seiichi TENPAKU

NAME

picola – Time domain compression/expansion.

SYNOPSIS

picola *filename*
picola –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **picola**.
The *parameter*s of **picola** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
MIN FREQUENCY	: 50.0 Hz
MAX FREQUENCY	: 500.0 Hz
COMPRESSION RATIO	: 1.7
INPUT FILE NAME	: TMP.DAT short
OUTPUT FILE NAME	: TMP.OUT short

When **picola** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing function.

MIN FREQUENCY
Sets the minimum fundamental frequency.

MAX FREQUENCY
Sets the maximum fundamental frequency.

COMPRESSION RATIO
Sets the compression/expansion ratio. When the value of "COMPRESSION RATIO" is a positive number, the input data is expanded. When the value of "COMPRESSION RATIO" is a negative number, the input data is compressed.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results, The format of output data is short integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/~/', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% picola
Time domain compression/expansion.
usage :: picola filename
         picola -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
MIN FREQUENCY           : 50.0 Hz
MAX FREQUENCY           : 500.0 Hz
```

```
COMPRESSION RATIO       : 1.7
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.OUT short
example% picola > temp
Time domain compression/expansion.
usage :: picola filename
        picola -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
MIN FREQUENCY           : 50.0 Hz
MAX FREQUENCY           : 500.0 Hz
COMPRESSION RATIO       : 1.7
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.OUT short
example% picola temp
```

AUTHOR

Seiichi TENPAKU

SEE ALSO

Morita, N. and Itakura, F. "Time-Scale Modification Algorithm for Speech by Use of Autocorrelation Method and Its Evaluation", IEICE Tech. Report EA86-5, pp. 9-16, 1986 (Japanese)

NAME

pitcher – Pitch Extraction (correlation coefficients of polarity).

SYNOPSIS

pitcher *filename*
pitcher –o *parameter* ...

USAGE

filename contains *parameter*s, which are concerned with **pitcher**.
The *parameter*s of **pitcher** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
WINDOW TYPE	: HANNING
FRAME PERIOD	: 5 msec
MINIMUM FREQUENCY	: 70 Hz
MAXIMUM FREQUENCY	: 300 Hz
THRESHOLD POWER	: 40 dB
INPUT FILE NAME	: TMP.DAT short
PITCH FILE NAME	: TMP.PIT float
POWER FILE NAME	: TMP.POW float

When **pitcher** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing function.

WINDOW TYPE
Sets the type of windowing function. The type of windowing function can be chosen from the following table:

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

If an unknown type of windowing function is specified, the type of windowing function is automatically reduced to RECTANGULAR without messages.

FRAME PERIOD
Sets the duration of frame period.

MINIMUM FREQUENCY
Sets the minimum fundamental frequency to search the pitch.

MAXIMUM FREQUENCY
Sets the maximum fundamental frequency to search the pitch.

THRESHOLD POWER
Sets the threshold power value. If the power value of one frame data is less than the value of "THRESHOLD POWER", the pitch extraction can not apply the frame.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

PITCH FILE NAME
Sets the file name for the output of the extrcted pitch. The format of output data is single-floating binary.

POWER FILE NAME
Sets the file name for the output of the calculated power. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% pitcher
Pitch Extraction (correlation coefficients of polarity).
usage :: pitcher filename
        pitcher -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
WINDOW TYPE             : HANNING
FRAME PERIOD            : 5 msec
MINIMUM FREQUENCY       : 70 Hz
MAXIMUM FREQUENCY       : 300 Hz
THRESHOLD POWER         : 40 dB
INPUT FILE NAME         : TMP.DAT short
PITCH FILE NAME         : TMP.PIT float
POWER FILE NAME         : TMP.POW float
example% pitcher > temp
Pitch Extraction (correlation coefficients of polarity).
usage :: pitcher filename
        pitcher -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
WINDOW TYPE             : HANNING
FRAME PERIOD            : 5 msec
MINIMUM FREQUENCY       : 70 Hz
MAXIMUM FREQUENCY       : 300 Hz
THRESHOLD POWER         : 40 dB
INPUT FILE NAME         : TMP.DAT short
PITCH FILE NAME         : TMP.PIT float
POWER FILE NAME         : TMP.POW float
example% pitcher temp
```

AUTHOR

Seiichi TENPAKU

NAME

syn_pole, syn_zero – Single formant/anti-formant filter.

SYNOPSIS

syn_pole *filename*
syn_pole –o *parameter ...*

syn_zero *filename*
syn_zero –o *parameter ...*

DESCRIPTION

syn_pole is a single formant filter.
syn_zero is a single anti-formant filter.

USAGE

filename contains *parameter*s, which are concerned with these commands. The *parameter*s are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
CENTER FREQUENCY	: 0.0 Hz
BANDWIDTH	: 200.0 Hz
INPUT FILE NAME	: TMP.DAT short
OUTPUT FILE NAME	: TMP.OUT short

When the command name is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

CENTER FREQUENCY
Sets the center frequency.

BANDWIDTH
Sets the bandwith.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results. The format of output data is short integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/'/', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

differ(L), hpf1(L), lpf1(L)

EXAMPLE

example% syn_pole
Single formant filter.
usage :: syn_pole filename
syn_pole -o arguments

Defaults are as follows.

SAMPLING FREQUENCY	: 20.0 kHz
CENTER FREQUENCY	: 0.0 Hz
BANDWIDTH	: 200.0 Hz
INPUT FILE NAME	: TMP.DAT short

```
OUTPUT FILE NAME        : TMP.OUT short
example% syn_pole > temp
Single formant filter.
usage :: syn_pole filename
        syn_pole -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
CENTER FREQUENCY        : 0.0 Hz
BANDWIDTH               : 200.0 Hz
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.OUT short
example% syn_pole temp
```

AUTHOR

Seiichi TENPAKU

NAME

power – Calculation of power with window normalization.

SYNOPSIS

power *filename*
power –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **power**.
The *parameter*s of **power** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
WINDOW TYPE	: HANNING
FRAME PERIOD	: 5 msec
INPUT FILE NAME	: TMP.DAT short
OUTPUT FILE NAME	: TMP.OUT float

When **power** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing function.

WINDOW TYPE
Sets the type of windowing function. The type of windowing function can be chosen from the following table:

RECTANGULAR
HANNING
HAMMING
BLACKMAN
BARTLETT
SINC

If an unknown type of windowing function is specified, the type of windowing function is automatically reduced to RECTANGULAR without messages.

FRAME PERIOD
Sets the duration of frame period.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results. The format of output data is single-floating binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% power
Calculation of power with window normalization.
usage :: power filename
       power -o arguments

Defaults are as follows.
SAMPLING FREQUENCY        : 20.0 kHz
```

WINDOW LENGTH : 30 msec
WINDOW TYPE : HANNING
FRAME PERIOD : 5 msec
INPUT FILE NAME : TMP.DAT short
OUTPUT FILE NAME : TMP.OUT float
example% power > temp
Calculation of power with window normalization.
usage :: power filename
power -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY : 20.0 kHz
WINDOW LENGTH : 30 msec
WINDOW TYPE : HANNING
FRAME PERIOD : 5 msec
INPUT FILE NAME : TMP.DAT short
OUTPUT FILE NAME : TMP.OUT float
example% power temp

AUTHOR

Seiichi TENPAKU

NAME

separate – split an ascii stream

SYNOPSIS

separate *n* [*file*]
separate –r *n m* [*file*]
separate –p *n m* [*file*]

DESCRIPTION

1) **separate** *n* [*file*]
Get the *n* th column.
2) **separate** –r *n m* [*file*]
Get columns *n* through *m.*
3) **separate** –p *n m* [*file*]
Get columns *n* and *m.*
In each case, **separate** displays the results on the standard output. The column number starts at 1. If *file* is not present, **separate** reads data from the standard input.

SEE ALSO

merge(L)

EXAMPLE

```
example% cat data.ascii
a       1       2
b       2       4
c       3       6
example% separate 1 data.ascii
a
b
c
example% separate 2 data.ascii
1
2
3
example% separate -r 1 2 data.ascii
a       1
b       2
c       3
example% separate -p 1 3 data.ascii
a       2
b       4
c       6
example% cat data.ascii | separate 3
2
4
6
```

AUTHOR

Seiichi TENPAKU

NAME

smath – calulate arithmetic functions using the standard input/output stream.

SYNOPSIS

smath *function* [*argment*]

smath help

DESCRIPTION

smath reads data from the standard input and calculates using the arithmetic function. Then, **smath** prints out the results to the standard output. In following explanations, The known arithmetic functions are as follows:

erf(x) returns the error function of x.
erfc(x) returns 1.0-erf(x).
exp(x) returns the exponential function e**x.
log(x) returns the natural logarithm of x.
log10(x) return the logarithm to base 10.
pow(x,y) returns x**y. pow(x,0.0) is 1 for all x.
pow10(x) returns 10**x.
sqrt(x) returns the square root of x.
cbrt(x) returns the cube root of x.
sinh(x) returns the hyperbolic sine of x.
cosh(x) returns the hyperbolic cosine of x.
tanh(x) returns the hyperbolic tangent of x.
asinh(x) returns the inverse hyperbolic sine of x.
acosh(x) returns the inverse hyperbolic cosine of x.
atanh(x) returns the inverse hyperbolic tangent of x.
sin(x) returns the sine function of x. x are radian arguments.
cos(x) returns the cosine function of x. x are radian arguments.
tan(x) returns the tangent function of x. x are radian arguments.
asin(x) returns the arc sine in the range -PI/2 to PI/2.
acos(x) returns the arc cosine in the range 0 to PI.
atan(x) returns the arc tangent of x in the range -PI/2 to PI/2.
fabs(x) returns the absolute value of x.
floor(x) returns the greatest integral value less than or equal to x.
ceil(x) returns the least integral value greater than or equal to x.
add(x,y) returns the value of (x + y).
sub(x,y) returns the value of (x - y).
mul(x,y) returns the value of (x * y).
div(x,y) returns the value of (x / y).
inv(x) returns the value of (1 / x).

EXAMPLE

```
example% cat data.ascii
1
2
3
example% cat data.ascii | smath mul 10
10.000000
20.000000
30.000000
example% cat data.ascii | smath log10
0.000000
0.301030
0.477121
```

```
example% cat data.ascii | smath log10 | smath mul 10
0.000000
3.010300
4.771210
```

AUTHOR

Seiichi TENPAKU

NAME

spc_dist – Calculate Spectrum Distortion.

SYNOPSIS

spc_dist *filename*
spc_dist **–o** *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **spc_dist**.
The *parameter*s of **spc_dist** are listed below ::

SIZE OF ARRAY	: 512
ORIGINAL FILE NAME	: TMP.ORG float
REFERENCE FILE NAME	: TMP.REF float
DIFFERENCE FILE NAME	: TMP.DIS float
INFORMATION FILE NAME	: TMP.IFO ascii

When **spc_dist** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SIZE OF ARRAY
Sets the array size of one frame data.

ORIGINAL FILE NAME
Sets the file name of input original data. The format of input data must be single-floating binary.

REFERENCE FILE NAME
Sets the file name of input refference data. The format of input data must be single-floating binary.

DIFFERENCE FILE NAME
Sets the file name of output differences in each frame. The format of input data is single-floating binary.

INFORMATION FILE NAME
Sets the file name for output of results.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

cep_dist(L), dtw_dist.(L), euclid_dist(L),

EXAMPLE

```
example% spc_dist
Calculate Spectrum Distortion.
usage :: spc_dist filename
        spc_dist -o arguments

Defaults are as follows.
SIZE OF ARRAY               : 512
ORIGINAL FILE NAME          : TMP.ORG float
REFERENCE FILE NAME         : TMP.REF float
DIFFERENCE FILE NAME        : TMP.DIS float
INFORMATION FILE NAME       : TMP.IFO ascii
example% spc_dist > temp
Calculate Spectrum Distortion.
usage :: spc_dist filename
        spc_dist -o arguments
```

Defaults are as follows.

```
example% cat temp
SIZE OF ARRAY              : 512
ORIGINAL FILE NAME         : TMP.ORG float
REFERENCE FILE NAME        : TMP.REF float
DIFFERENCE FILE NAME       : TMP.DIS float
INFORMATION FILE NAME      : TMP.IFO ascii
example% spc_dist temp
```

AUTHOR

Seiichi TENPAKU

NAME

subset – Cutting a subset of the file.

SYNOPSIS

subset *filename*
subset –o *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **subset.**
The *parameter*s of **subset** are listed below ::

SOURCE FILE NAME	: TMP.SRC
RESULT FILE NAME	: TMP.DST
SIZE OF ARRAY	: 2 byte
OFFSET	: 0
LENGTH	: 100

When **subset** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SOURCE FILE NAME
Sets the file name of input data. The format of input data must be binary. There are no restrictions as to the file length.

RESULT FILE NAME
Sets the file name for the output of results. The format of output data is binary.

SIZE OF ARRAY
Sets the size of data in byte-order.

OFFSET
Sets the offset of the input file.

LENGTH
Sets the length of the input file. The value of "LENGTH" must be less than the value of subtract the total length of the input data from the value of "OFFSET". For example, when the format of input data is short integer binary, the value of "SIZE OF ARRAY" is set 2. If the size of the input data is 200 bytes, the total length is 100. And if the value of "OFFSET" is set 20, the value of "LENGTH" must be less than 80 (= 100 - 20).

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% subset
Cutting a subset of the file.
usage :: subset filename
        subset -o arguments

Defaults are as follows.
SOURCE FILE NAME        : TMP.SRC
RESULT FILE NAME        : TMP.DST
SIZE OF ARRAY           : 2 byte
OFFSET                  : 0
LENGTH                  : 100
example% bcat -s TMP.SRC
1
2
3
```

```
4
5
6
7
8
9
10
example% subset -o "OFFSET : 3" "LENGTH : 5"
!10
example% bcat -s TMP.DST
4
5
6
7
8
```

SEE ALSO

bcat(L)

AUTHOR

Seiichi TENPAKU

NAME

syn_cascade – Cascade formant synthesizer.

SYNOPSIS

syn_cascade *filename*
syn_cascade –o *parameter ...*

USAGE

filename contains *parameters*, which are concerned with **syn_cascade**.
The *parameters* of **syn_cascade** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
FRAME PERIOD	: 5 msec
PREEMPAHSIS	: 0.98
GAIN CONTROL	: 80 dB
NUMBER OF FORMANTS	: 5
SOURCE VOICE FILE NAME	: TMP.SRC float
FORMANT FREQUENCY FILE NAME	: TMP.FRQ float
FORMANT BANDWIDTH FILE NAME	: TMP.BND float
OUTPUT FILE NAME	: TMP.SYN short

When **syn_cascade** is entered without any arguments, the command diplays the *parameters* and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency.

FRAME PERIOD
Sets the duration of frame period.

PREEMPAHSIS
Sets the pre-emphasis factor. The range of this value is 0.0 to 1.0.

GAIN CONTROL
Sets the gain. The maximum amplitude of the synthesized speech is adjusted to the value of "GAIN CONTROL".

NUMBER OF FORMANTS
Sets the number of formants.

SOURCE VOICE FILE NAME
Sets the file name of source data. The format of source data must be single-floating binary. There are no restrictions as to the file length.

FORMANT FREQUENCY FILE NAME
Sets the file name of input formant frequency data. The format of input formant frequency data must be single-floating binary.

FORMANT BANDWIDTH FILE NAME
Sets the file name of input formant bandwidth data. The format of input formant bandwidth data must be single-floating binary.

OUTPUT FILE NAME
Sets the file name for the output of synthesized speech. The format of output data is short integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

example% syn_cascade
Cascade formant synthesizer.

usage :: syn_cascade filename
syn_cascade -o arguments

Defaults are as follows.

SAMPLING FREQUENCY	: 20.0 kHz
FRAME PERIOD	: 5 msec
PREEMPAHSIS	: 0.98
GAIN CONTROL	: 80 dB
NUMBER OF FORMANTS	: 5
SOURCE VOICE FILE NAME	: TMP.SRC float
FORMANT FREQUENCY FILE NAME	: TMP.FRQ float
FORMANT BANDWIDTH FILE NAME	: TMP.BND float
OUTPUT FILE NAME	: TMP.SYN short

example% syn_cascade > temp
Cascade formant synthesizer.
usage :: syn_cascade filename
syn_cascade -o arguments

Defaults are as follows.
example% cat temp

SAMPLING FREQUENCY	: 20.0 kHz
FRAME PERIOD	: 5 msec
PREEMPAHSIS	: 0.98
GAIN CONTROL	: 80 dB
NUMBER OF FORMANTS	: 5
SOURCE VOICE FILE NAME	: TMP.SRC float
FORMANT FREQUENCY FILE NAME	: TMP.FRQ float
FORMANT BANDWIDTH FILE NAME	: TMP.BND float
OUTPUT FILE NAME	: TMP.SYN short

example% syn_cascade temp

AUTHOR

Seiichi TENPAKU

NAME

syn_parcor – PARCOR Synthesizer.

SYNOPSIS

syn_parcor *filename*
syn_parcor –o *parameter ...*

USAGE

filename contains *parameters*, which are concerned with **syn_parcor**.
The *parameters* of **syn_parcor** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
FRAME PERIOD	: 5 msec
ORDER OF LPC	: 16
GAIN CONTROL	: 80.0 dB
SOURCE FILE NAME	: TMP.SRC float
PARCOR FILE NAME	: TMP.PAR float
OUTPUT FILE NAME	: TMP.SYN short

When **syn_parcor** is entered without any arguments, the command diplays the *parameters* and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency.

FRAME PERIOD
Sets the duration of frame period.

ORDER OF LPC
Sets the order of LPC (Linear Prediction Coefficients).

GAIN CONTROL
Sets the gain. The maximum amplitude of the synthesized speech is adjusted to the value of "GAIN CONTROL".

SOURCE FILE NAME
Sets the file name of source data. The format of source data must be single-floating binary. There are no restrictions as to the file length.

PARCOR FILE NAME
Sets the file name of input PARCOR parameters data. The format of input formant bandwidth data must be single-floating binary.

OUTPUT FILE NAME
Sets the file name for the output of synthesized speech. The format of output data is short integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/~/', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

EXAMPLE

```
example% syn_parcor
PARCOR Synthesizer.
usage :: syn_parcor filename
      syn_parcor -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
FRAME PERIOD            : 5 msec
```

```
ORDER OF LPC                : 16
GAIN CONTROL                : 80.0 dB
SOURCE FILE NAME            : TMP.SRC float
PARCOR FILE NAME            : TMP.PAR float
OUTPUT FILE NAME            : TMP.SYN short
example% syn_parcor > temp
PARCOR Synthesizer.
usage :: syn_parcor filename
        syn_parcor -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY          : 20.0 kHz
FRAME PERIOD                : 5 msec
ORDER OF LPC                : 16
GAIN CONTROL                : 80.0 dB
SOURCE FILE NAME            : TMP.SRC float
PARCOR FILE NAME            : TMP.PAR float
OUTPUT FILE NAME            : TMP.SYN short
example% syn_parcor temp
```

AUTHOR

Seiichi TENPAKU

NAME

taper – Tapering the data.

SYNOPSIS

taper *filename*
taper **–o** *parameter* ...

USAGE

filename contains *parameter*s, which are concerned with **taper**.
The *parameter*s of **taper** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
RISE ENVELOPE	: 10 msec
FALL ENVELOPE	: 10 msec
OFFSET	: 0.0 msec
LENGTH	: -1.0 msec
TAPER FUNCTION	: LINEAR
INPUT FILE NAME	: TMP.DAT short
OUTPUT FILE NAME	: TMP.OUT short

When **taper** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency.

RISE ENVELOPE
Sets the rising duration.

FALL ENVELOPE
Sets the falling duration.

OFFSET
Sets the offset time of tapering function.

LENGTH
Sets the duration of tapering function. When the value of "LENGTH" is negative, the duration is adjusted to the file length of the input data.

TAPER FUNCTION
Sets the type of tapering function. The type of tapering function can be chosen from the following table:

LINEAR
SECOND
SINE
SINC

If an unknown type of tapering function is specified, the type of tapering function is automatically reduced to LINEAR without messages.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name of output data. The format of input data must be short integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/~/', '/./' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% taper
Tapering the data.
usage :: taper filename
        taper -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
RISE ENVELOPE           : 10 msec
FALL ENVELOPE           : 10 msec
OFFSET                  : 0.0 msec
LENGTH                  : -1.0 msec
TAPER FUNCTION          : LINEAR
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.OUT short
example% taper > temp
Tapering the data.
usage :: taper filename
        taper -o arguments

Defaults are as follows.
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
RISE ENVELOPE           : 10 msec
FALL ENVELOPE           : 10 msec
OFFSET                  : 0.0 msec
LENGTH                  : -1.0 msec
TAPER FUNCTION          : LINEAR
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.OUT short
example% taper temp
```

AUTHOR

Seiichi TENPAKU

NAME

transpose – Transpose array (X <=> Y).

SYNOPSIS

transpose *filename*
transpose **–o** *parameter ...*

DESCRIPTION

transpose exchanges a horizontal axis for a vertical axis.

USAGE

filename contains *parameter*s, which are concerned with **transpose**.
The *parameter*s of **transpose** are listed below ::

```
INPUT FILE NAME      : TMP.SRC
OUTPUT FILE NAME     : TMP.DST
SIZE OF DATA         : 2 byte
NUMBER OF X AXIS     : 16
```

When **transpose** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

INPUT FILE NAME
Sets the file name of input data. The format of input data must be binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of results. The format of output data is binary.

SIZE OF DATA
Sets the size of data in byte-order. For example, when the format of input data is short integer binary, the value of "SIZE OF DATA" must be set 2.

NUMBER OF X AXIS
Sets the item number of the horizontal axis.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

EXAMPLE

```
example% transpose
Transpose array (X <=> Y).
usage :: transpose filename
         transpose -o arguments

Defaults are as follows.
INPUT FILE NAME      : TMP.SRC
OUTPUT FILE NAME     : TMP.DST
SIZE OF DATA         : 2 byte
NUMBER OF X AXIS     : 16
example% acat -s TMP.SRC
1 2
3 4
5 6
example% transpose -o "NUMBER OF X AXIS : 2"
!12
example% bcat -p 3 -s TMP.DST
1               3               5
2               4               6
```

SEE ALSO

acat(L), bcat(L)

AUTHOR

Seiichi TENPAKU

NAME

zerocrs – Counting the zero cross points.

SYNOPSIS

zerocrs *filename*
zerocrs **–o** *parameter ...*

USAGE

filename contains *parameter*s, which are concerned with **zerocrs**.
The *parameter*s of **zerocrs** are listed below ::

SAMPLING FREQUENCY	: 20.0 kHz
WINDOW LENGTH	: 30 msec
FRAME PERIOD	: 5 msec
INPUT FILE NAME	: TMP.DAT short
OUTPUT FILE NAME	: TMP.ZRO short

When **zerocrs** is entered without any arguments, the command diplays the *parameter*s and default settings on the standard output.

PARAMETERS

SAMPLING FREQUENCY
Sets the sampling frequency of input data.

WINDOW LENGTH
Sets the duration of windowing.

FRAME PERIOD
Sets the duration of frame period.

INPUT FILE NAME
Sets the file name of input data. The format of input data must be short integer binary. There are no restrictions as to the file length.

OUTPUT FILE NAME
Sets the file name for the output of the results. The format of output data is short integer binary.

NOTE

File names can be set using absolute pathnames or relative pathnames. For setting relative pathnames, '/./', '/../' and '/../' can be used. The maximum character length of pathnames is fixed at 128.

SEE ALSO

find_zerocrs(L)

EXAMPLE

```
example% zerocrs
Counting the zero cross points.
usage :: zerocrs filename
        zerocrs -o arguments

Defaults are as follows.
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
FRAME PERIOD            : 5 msec
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.ZRO short
example% zerocrs > temp
Counting the zero cross points.
usage :: zerocrs filename
        zerocrs -o arguments

Defaults are as follows.
```

```
example% cat temp
SAMPLING FREQUENCY      : 20.0 kHz
WINDOW LENGTH           : 30 msec
FRAME PERIOD            : 5 msec
INPUT FILE NAME         : TMP.DAT short
OUTPUT FILE NAME        : TMP.ZRO short
example% zerocrs temp
```

AUTHOR

Seiichi TENPAKU