
The MicroWave Speech Robot

Dr. Georg Müller “The Swiss Doctor”

PPG 2002, Birmingham
16.02.2002

Welcome Speech

Hello Audience
Welcome to PPG 2002

I am the Speech Robot living in the Waldorf MicroWave.
The Swiss Doctor will tell you now how I am working.

Enjoy the talk.

Historic remarks and anecdotes

- **November 93**

Waldorf announced that the new V2.0 Upgrade will contain algorithmically created Synthesized Speech Wavetables
The first table mentioned was 1-2-3-4-5

- **December 93**

Beta for V2.0 started

- **January 94**

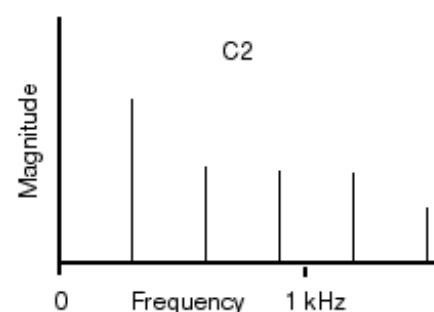
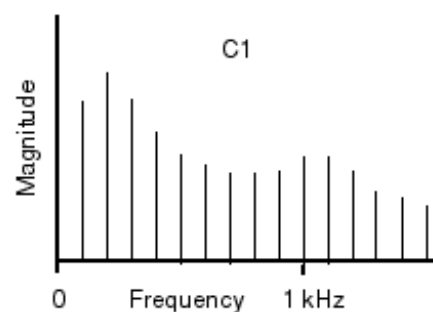
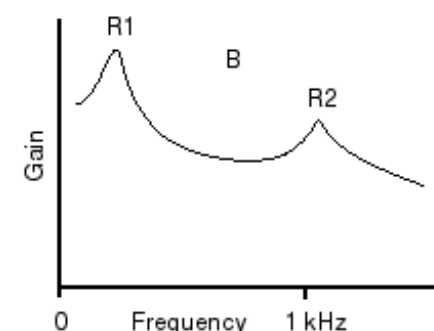
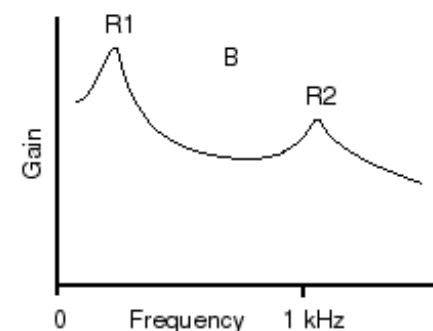
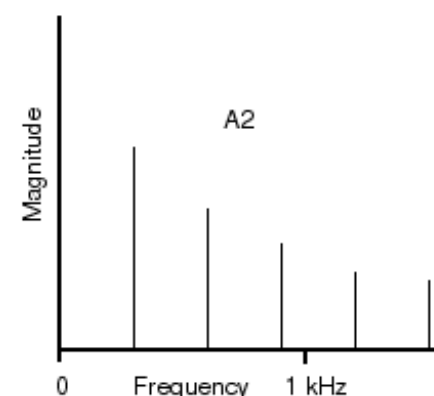
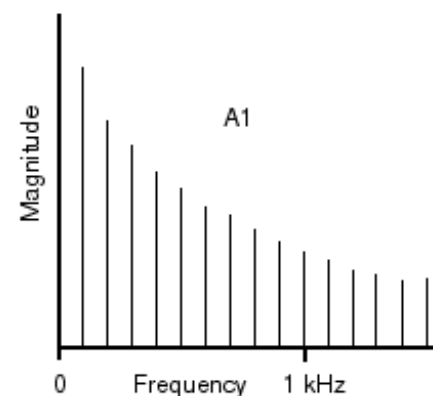
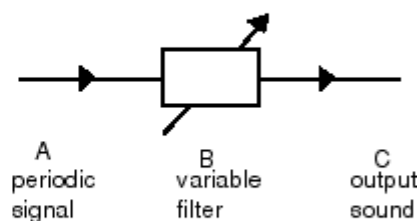
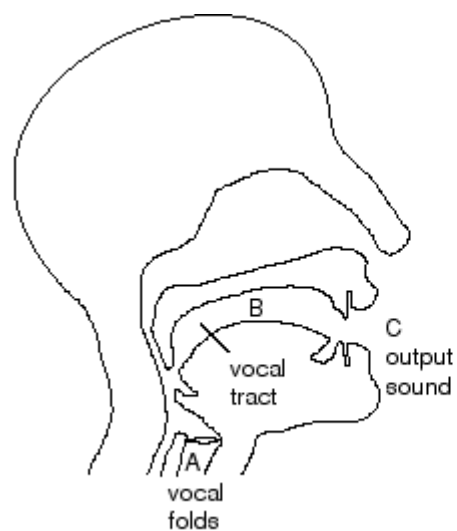
Discussion on Beta List about sense or nonsense of Speech Robot took place

My suggestion about Nineteen (Paul Hardcastle) was accepted
V1.7xx included table "Thanks to George" because of my windowing idea to smooth harsh sounding Sync tables

- **March 95**

V2.0 released with 1-2-3-4-5, 19/20 in ROM and Techno Music, Revolution and Computer World in my Soundset

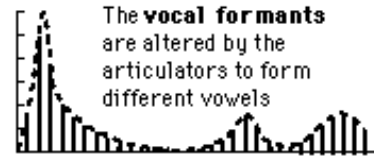
The source-filter model of the vocal tract



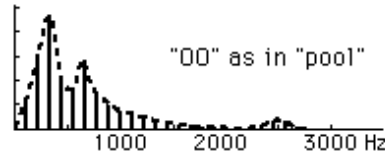
Vocal Formants



"EE"
as in "Heed"



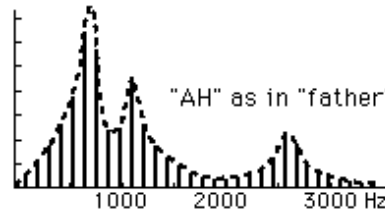
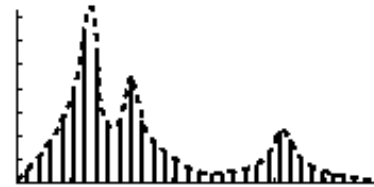
The **vocal formants** are altered by the articulators to form different vowels



"OO" as in "pool"



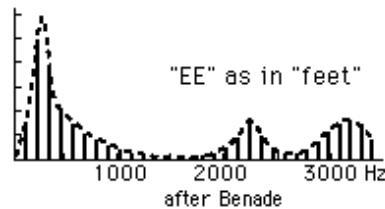
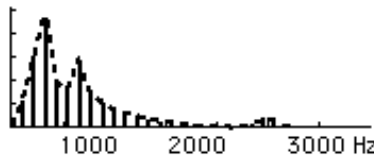
"AH"
as in "Hard"



"AH" as in "father"

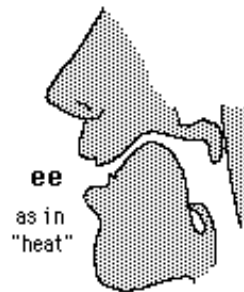


"OO"
as in "Who'd"

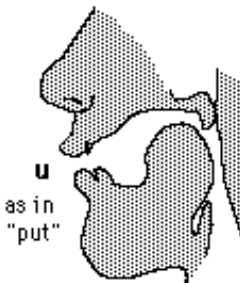


"EE" as in "feet"

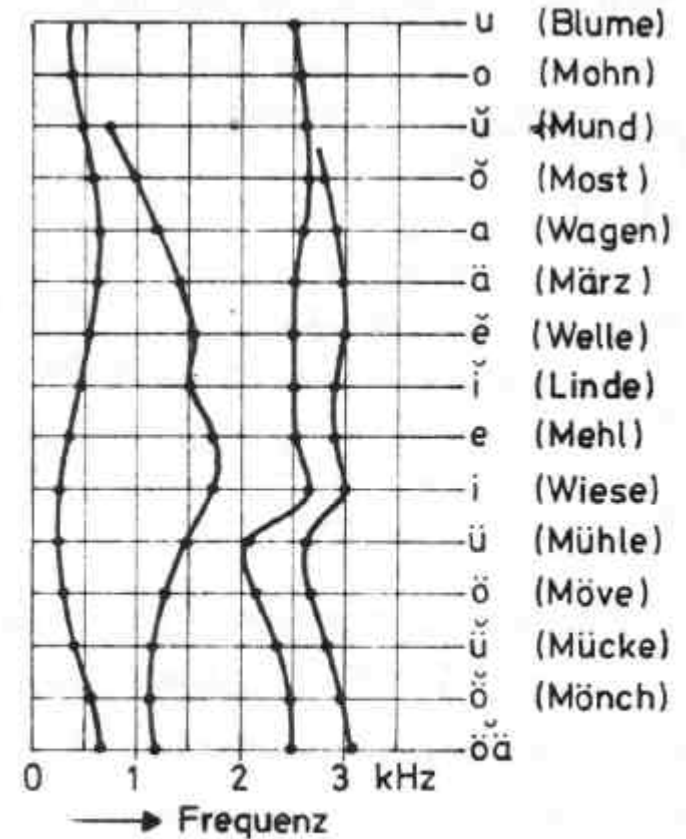
after Benade



ee
as in
"heat"



u
as in
"put"

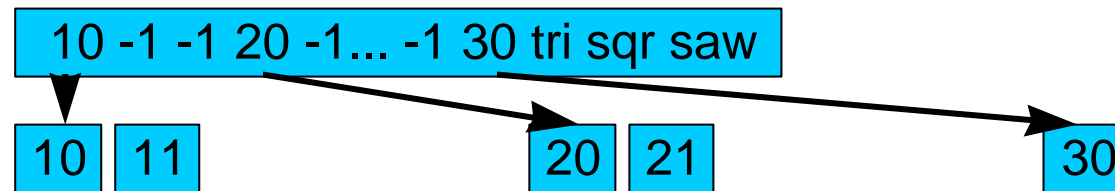


Lage der Formantbereiche
der Vokale über der Frequenz.

How it is working

- The Microwave has 3 types of Wavetables: Normal, UPAW, Robot
- Distinction is done by Magic Words \$12DECODE or \$DEADBEEF
- Structure of different Wavetables (Wavecontroltable and Waves)

- Normal



- UPAW

\$12DECODE [UPAW Code]

- Robot

\$DEADBEEF 15 dummy data



Pointer in Wavecontroltable points to 8 Waves containing formant and noise data

Format of the formant and noise list

- Features of Atari ST sound chip AY-3-8910 are emulated
3 voices plus 1 noise channel
- 60 entries, each 8 bytes long. The format of such an entry:
 - 1.) Level Formant 1
0 - Max level, 8 - silence, sort of negative logarithmus to base 2
 - 2.) Formant 1 Frequency
this is in a linear scale
 - 3.-6.) same for Formant 2 and 3

Format of the formant and noise list

- 7.) Noise Level
this time the positive logarithmus, base about 1.414

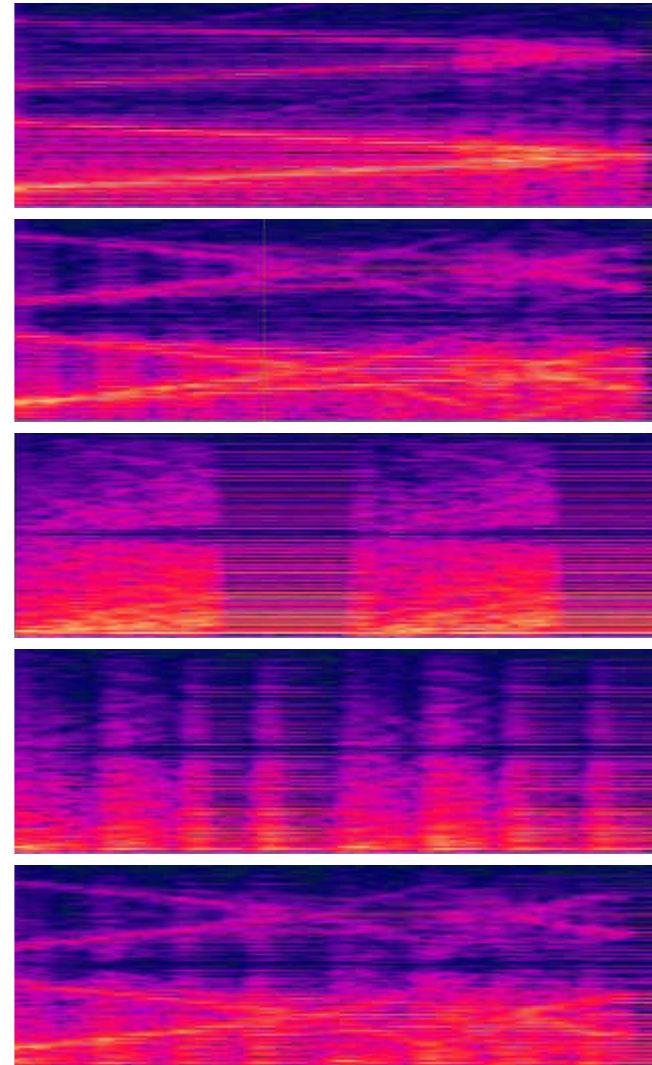
8.) Noise Frequency
"Pitch" of the noise

- An example for such a list

```
sp12345:!speech wavetable "12345"  
.byte 0,11,2,24,2,90,0,0  
.byte 0,11,2,25,2,89,0,0  
.byte 0,16,1,35,3,87,0,0  
.byte 0,22,0,43,4,87,0,0
```

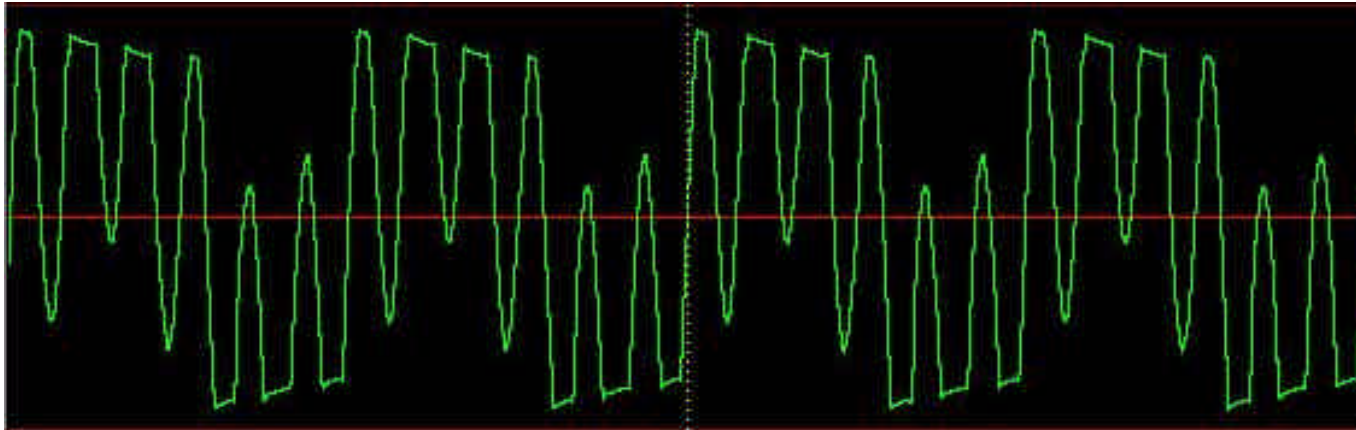

Examples of simple formant lists

- one formant sliding upwards
- two formants sliding upwards
- noise frequency sliding upwards
- noise frequency sliding upwards plus rhythmic pattern
- all together

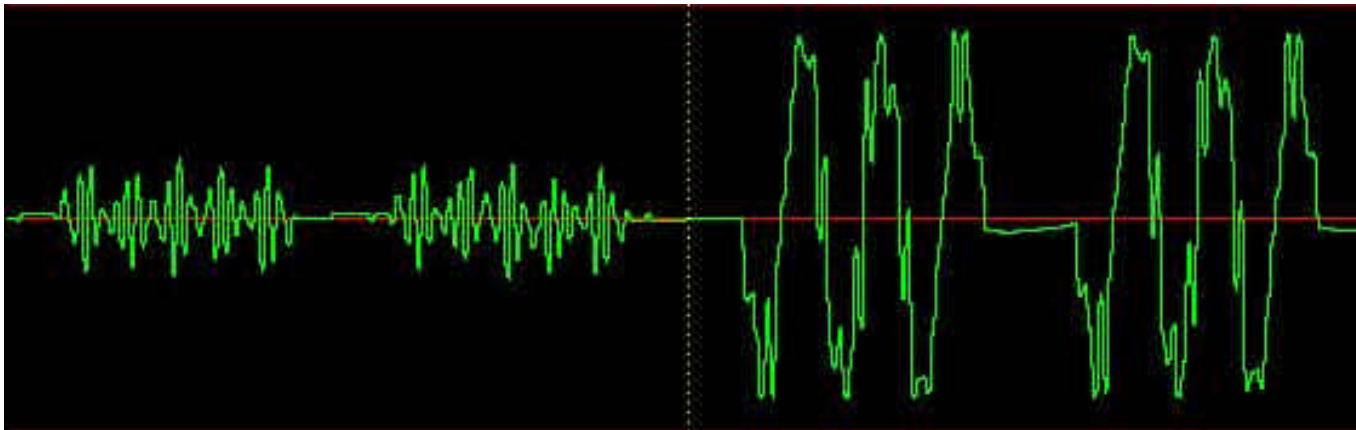


Differences between normal and robot waves

Normal wave



Robot wave



How to create such a list for speech

- The program STSPEECH for the Atari ST is used to convert text into phonemes and to calculate the formant and noise information needed.
- A wrapper program MWROBOT is calling STSPEECH, then converting that output into the \$DEADBEEF format and sending the right SysEx to the MicroWave.
- Stenfan Stenzel ported STSPEECH meanwhile to the PC platform.

The Atari ST Speech Synth at Work

```
MWRobot 1.0
Usage: MWROBOT.TTP [-WWW] [-tTT] [-oFILENAME]
where "WWW" is wave number, default 246,
"TT" is wavetable numer, default 33,
"FILENAME" is the name of the optinal Formant List Output File.
Current Parameters: Wave #246, Wavetable #33, No File Output.
Enter desired Sentence and hit <Return> or quit immediately by <Control-C>
Starting Speech Synthesizer now...

MC68000/AY-3-8910 SPEECH SYNTHESIZER V 2.0
Copyright 1986 A.D.BEVERIDGE & M.H.DAY
ALL RIGHTS RESERVED.

>welcome to pee pee gee two thousand and two
```

Speech Synth Ported to PC Platform

```
MC68000/AY-3-8910 SPEECH SYNTHESIZER V:2.0
Copyright 1986 A.D.BEVERIDGE & M.N.DAY
ALL RIGHTS RESERVED.

welcome to pee pee gee two thousand and two
WEHLKUHM IUX PIY2 PIY2 GIY2 TUV THAW2ZAEND AEND TUV
welcome to ppg 2002
WEHLKUHM IUX PG TUV2 ZIH2ROW ZIH2ROW TUV2
waldorf microwave
MAOLDAORF MAY2KROHWAEU
waldorf microwayve
MAOLDAORF MAY2KROHWEY1U
```

Examples of robot voices

- **Raw Robot Tables**

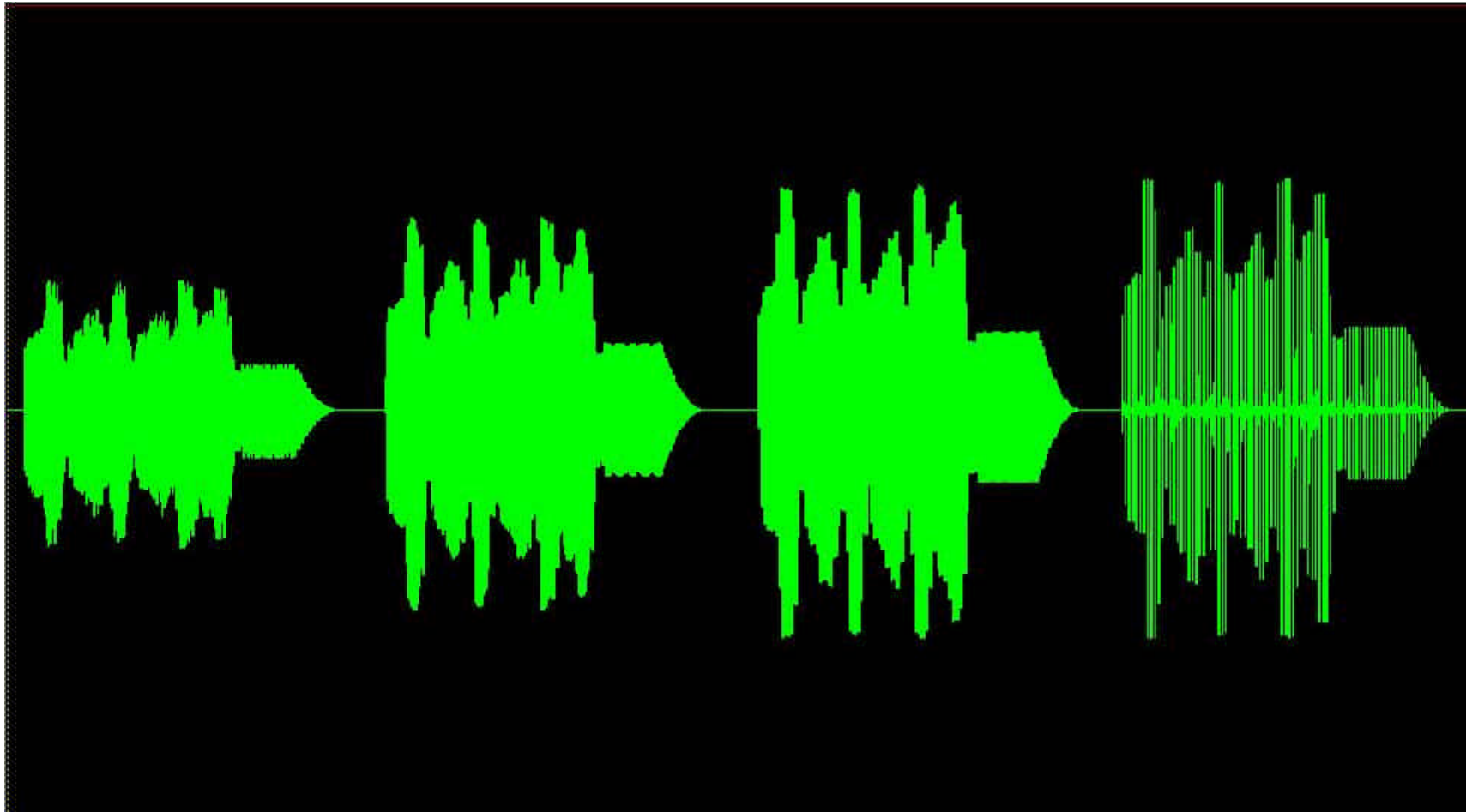
Welcome to PPG 2002	Atari	MicroWave
Resistance is futile	Atari	MicroWave
He is dead, Jim	Atari	MicroWave
Sorry Dave I am afraid I can't do that	Atari	MicroWave

- **Sounds using Robot Tables**

MW-Receiver HH	MicroWave
Press C's WMF	MicroWave
Computer World	MicroWave
Revolution	MicroWave
TecknoTeckno	MicroWave
Resistance is futile	MicroWave

Steganographic use of Wavetables

- Guess what's the message hidden in this Wavetable?



Steganographic use of Wavetables

- Palm Products Germany!

