

Advanced Topics in Computer Music (MARE 502)

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Outline

- 1 Recapitulation
- 2 Csound at the Command Line
- 3 Spatialisation with Csound
- 4 Conclusion

Recapitulation: Physical Modelling

Question

Which physical modelling approaches do you know?

- Csound at the Command Line

UNIX Command Line

- Textual interface to operating system
- **Advantages:** programmable interface (e.g., for automatic complex or repetitive tasks)
- **Disadvantage:** harder to learn and use than graphical interface
- Recent MS Windows equivalent: PowerShell

Environment Variables I

- OS-wide settings
- Important example: PATH variable contains list of directories with executables
 - Try executing shell command `echo $PATH`
- Environment variables commonly set in shell initialisation file (e.g., `~/.profile`)

Environment Variables II

Important Csound environment variables with example settings

Directory for resulting sound files

```
export SFDIR=~ /csound/Output/
```

Directory for input sound files

```
export SSDIR=~ /csound/Samples/
```

Directory for analysis files

```
export SADIR=~ /csound/Analysis/
```

Csound on Command Line I

General syntax

Traditional format with orchestra and score files

```
csound [-flags] file.orc file.sco
```

Unified file format

```
csound [-flags] file.csd
```

Example (Outputting named AIFF file (non-realtime))

```
csound -A -o Chowning-Stria Chowning-Stria.csd
```


Csound on Command Line II

Documentation

- Start of doc section on Csound command

<http://www.csounds.com/manual/html/CommandTop.html>

- Csound command line flags

<http://www.csounds.com/manual/html/CommandFlags.html>

Using the Graphical Interface of QuteCsound

- Setting environment variables
- Rendering files in realtime and non-realtime

- Spatialisation with Csound

Amplitude Panning Exercise

Exercise

Program a stereo instrument that plays a mono soundfile. Implement stereo panning by modulating the amplitude (linear amplitude panning).

Amplitude Panning I

Problem of linear panning

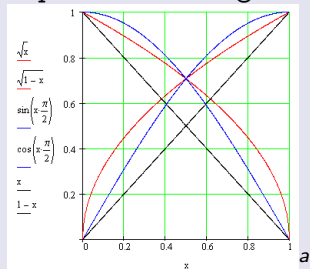
Hole in the middle!

Amplitude Panning II

Constant power panning

Instead of straight line use square root (constant power panning).

AmplitudePanning.csd



^aSource: <http://csounds.com/ezone/autumn1999/beginners/>

Amplitude Panning III

Generalisation to circular panning

Provides control for left-right and front-back dimensions

`CircularPan.csd`

Using Delays I

Exercise

Program a stereo instrument that plays a mono soundfile. Play the soundfile on one channel with a little delay compared to the other channel.

Use different delay times (0 msec to 100 msec): what is the perceptual effect of these different delay times?

Using Delays II

Different delay times: different perception

- Direction (Precedence Effect)
- Spaciousness
- Echo

Processing a Stereo Signal I

Rotation of a stereo signal

Translates stereo signal to MS stereo, rotates that and translates back

`RotateStereo.csd`

Distance "Fade"

Simultaneously applies multiple processings to emulate moving a stereo scene away into distance

- Lowpass filter
- Highpass filter
- Reverb

`DistanceEmulator.csd`

Binaural Panning

- Panning for headphones
- Dummy head recordings used for obtaining head-related transfer functions (HRTF)
 - Processes amplitude, delay times and spectrum

Example (Binaural panning)

`BinauralPanning.csd`

Multi-Channel Approaches

- Multi-channel spatialisation is key to turning presentation of sound from loudspeakers into something special

Vector base amplitude panning (VBAP)

Generalisation of amplitude panning for arbitrary 2-D or 3-D setups

Ambisonics

Recording and replay technique that encodes arbitrary (2-D) 3-D setups into a (3-channel) 4-channel format called B-format (first-order Ambisonics).

Modelling techniques that also model room acoustics

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Spatialisation Opcodes in Csound Manual

- Panning and Spatialization:
<http://www.csounds.com/manual/html/SigmoidPanspatl.html>
- Reverberation:
<http://www.csounds.com/manual/html/SigmoidReverbbtn.html>

Summary

- Csound at command line
- Spatialisation with Csound

Questionnaire

- Could you please fill in the questionnaire?