Advanced Topics in Computer Music (MARE 502)

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Outline

Introduction

How could we synthesize the sound of acoustic instruments?

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Why may we want to synthesize the sound of acoustic instruments?

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Why may we want to synthesize the sound of acoustic instruments?

What do you already know about physical modelling?

Mass-Spring Paradigm I

Characteristics

- Explicit modelling of individual particles (masses) that are connected by springs
- Highly flexible
  - Instruments can be compiled from multiple parts
  - Any part of instruments accessible (e.g. for excitation or damping)
- Computationally expensive

Mass-Spring Paradigm II

Implementations

- Cordis Anima (http://www-acroe.imag.fr/produits/logiciel/logiciel_en.html) sound examples: http://www-acroe.imag.fr/mediatheque/sonotheque/sonotheque_en.html
- Tao (http://taopm.sourceforge.net/) Compositional example: Torsten Anders (2003) With Shifting Joints (click for mp3)

Modal Synthesis I

Characteristics

- Represents modal data of instrument building blocks (e.g., frequencies, damping coefficients)
- Relatively flexible
  - Instruments can be compiled from multiple parts
  - Certain parts of instruments accessible (e.g. for excitation or damping)
- Medium in terms of efficiency

Modal Synthesis II

Implementations

- Modalys (http://forumnet.ircam.fr/701.html?L=1)
  Compositional example: Torsten Anders (1998). Kunststoff. five variations (click for mp3)
- Tassman (and other instruments by AAS, http://www.applied-acoustics.com/)
  sound examples:
  http://www.hvsynthdesign.com/tassman.php,
  http://www.applied-acoustics.com/tassman/overview/

Waveguides I

Characteristics

- Most efficient approach
- Least flexible approach
  - Instrument design quite complicated
  - Ready-made instruments used as-is
- Most commonly used approach (probably due to efficiency)

Implementations

- Only physical modelling approach that has been implemented in hardware; e.g., Yamaha's VL1 (1994) and VL70m (1996)
- Various software synthesizers and sound synthesis languages

Waveguides II

Compositional example (piano model by Scott Van Duyne):

Torsten Anders (1999). Klavierkreisel (click for mp3)

Karplus-Strong Algorithm: More Simple Relative of Waveguides

Screen cast

http://cnx.org/content/m15489/latest/sub_ks-theory.html

Physical Modelling in Csound

Instruments build from scratch

Using building blocks like delay lines and filters

Predefined physical models

- All predefined physical models in Csound based on digital waveguide synthesis
- Examples using predefined physical models by Iain McCurdy available at http://iainmccurdy.org/csound.html

Using Physical Models

How could we use physical models in Csound instruments?

Assignment

- Eduardo will post assignment in the portal on Friday.