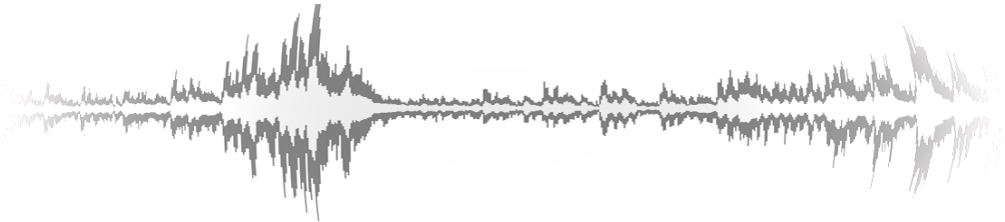
Digital Signal Processing for Music

Part 2: Introduction

alexander lerch



Georgia Tech Center for Music Technology
College of Design

introduction

digital technology

- examples of everyday digital (audio) technology
  - **music listening**:
    - audio compression
    - audio storage and streaming
    - equalization and loudness adaptation
    - ...
  - **music production and synthesis**
    - recording and editing
    - effects
    - denoising
  - **human computer interaction**
    - speech recognition
    - text-to-speech
  - ...

introduction

release of digital technology — production

Georgia Tech Center for Music Technology
College of Design

Product	Year
Sound Synthesis	
NED Synclavier Synthesizer/Sampler	1979
Fairlight CMI Synthesizer/Sampler	1979
Linn LM-1 Drumcomputer/Sampler	1980
E-MU Emulator I Sampling Keyboard	1981
Yamaha DX-7 Syntheziser	1983
Sound Processing/Effects	
Lexicon Delta-T 101 Digital Delay	1971
EMT 250 Digital Reverberation	1976
Lexicon L224 Digital Reverberation	1978
Sound Editing	
Sony DAE-1100 Digital Audio Editor	1980
Sony DAE-3000 Digital Audio Editor	1987
Sonic Solutions Harddisk Editing	1988
Other	
MIDI Standard	1983

introduction

release of digital technology — production

Georgia Tech Center for Music Technology
College of Design

Product	Year
Sound Synthesis	
NED Synclavier Synthesizer/Sampler	1979
Fairlight CMI Synthesizer/Sampler	1979
Linn LM-1 Drumcomputer/Sampler	1980
E-MU Emulator I Sampling Keyboard	1981
Yamaha DX-7 Syntheziser	1983
Sound Processing/Effects	
Lexicon Delta-T 101 Digital Delay	1971
EMT 250 Digital Reverberation	1976
Lexicon L224 Digital Reverberation	1978
Sound Editing	
Sony DAE-1100 Digital Audio Editor	1980
Sony DAE-3000 Digital Audio Editor	1987
Sonic Solutions Harddisk Editing	1988
Other	
MIDI Standard	1983

introduction

release of digital technology — production

Product	Year
Sound Synthesis	
NED Synclavier Synthesizer/Sampler	1979
Fairlight CMI Synthesizer/Sampler	1979
Linn LM-1 Drumcomputer/Sampler	1980
E-MU Emulator I Sampling Keyboard	1981
Yamaha DX-7 Syntheziser	1983
Sound Processing/Effects	
Lexicon Delta-T 101 Digital Delay	1971
EMT 250 Digital Reverberation	1976
Lexicon L224 Digital Reverberation	1978
Sound Editing	
Sony DAE-1100 Digital Audio Editor	1980
Sony DAE-3000 Digital Audio Editor	1987
Sonic Solutions Harddisk Editing	1988
Other	
MIDI Standard	1983

introduction

release of digital technology — production

Georgia Tech Center for Music Technology
College of Design

Product	Year
Sound Synthesis	
NED Synclavier Synthesizer/Sampler	1979
Fairlight CMI Synthesizer/Sampler	1979
Linn LM-1 Drumcomputer/Sampler	1980
E-MU Emulator I Sampling Keyboard	1981
Yamaha DX-7 Syntheziser	1983
Sound Processing/Effects	
Lexicon Delta-T 101 Digital Delay	1971
EMT 250 Digital Reverberation	1976
Lexicon L224 Digital Reverberation	1978
Sound Editing	
Sony DAE-1100 Digital Audio Editor	1980
Sony DAE-3000 Digital Audio Editor	1987
Sonic Solutions Harddisk Editing	1988
Other	
MIDI Standard	1983

introduction

release of digital technology — storage & consumer

Georgia Tech Center for Music Technology
College of Design

Digital Storage	Year
Professional	
PCM-1600 (U-matic)	1978
PCM-1 (Betamax)	1978
Digital Multitrack (3M, Sony)	1978
Alesis ADAT	1991
Tascam DA-88	1993
Consumer	
Compact Disc	1982/83
Digital Audio Tape (DAT)	1987
MiniDisc	1991
Digital Compact Cassette	1992
DVD-Video	1997
DVD-Audio	1999
SACD	1999

introduction

release of digital technology — storage & consumer

Georgia Tech Center for Music Technology
College of Design

Digital Storage	Year
Professional	
PCM-1600 (U-matic)	1978
PCM-1 (Betamax)	1978
Digital Multitrack (3M, Sony)	1978
Alesis ADAT	1991
Tascam DA-88	1993
Consumer	
Compact Disc	1982/83
Digital Audio Tape (DAT)	1987
MiniDisc	1991
Digital Compact Cassette	1992
DVD-Video	1997
DVD-Audio	1999
SACD	1999

introduction

reasons for digital equipment

- **storage**:
  - lossless copying and archiving of digital content
- **editing & processing**
  - splicing of recordings
  - fast convolution
  - granular processing/time-stretching/pitch-shifting
- **technical characteristics**
  - SNR, distortion, transfer functions, ...
- **dropping prices** for digital hardware and software (compared to analogue equipment)

introduction

reasons for digital equipment

- **storage**:
  - lossless copying and archiving of digital content
- **editing & processing**
  - splicing of recordings
  - fast convolution
  - granular processing/time-stretching/pitch-shifting
- **technical characteristics**
  - SNR, distortion, transfer functions, ...
- **dropping prices** for digital hardware and software (compared to analogue equipment)

introduction

reasons for digital equipment

- **storage**:
  - lossless copying and archiving of digital content
- **editing & processing**
  - splicing of recordings
  - fast convolution
  - granular processing/time-stretching/pitch-shifting
- **technical characteristics**
  - SNR, distortion, transfer functions, ...
- **dropping prices** for digital hardware and software (compared to analogue equipment)

introduction

reasons for digital equipment

- **storage**:
  - lossless copying and archiving of digital content
- **editing & processing**
  - splicing of recordings
  - fast convolution
  - granular processing/time-stretching/pitch-shifting
- **technical characteristics**
  - SNR, distortion, transfer functions, ...
- **dropping prices** for digital hardware and software (compared to analogue equipment)

introduction

current trends & developments

Georgia Tech Center for Music Technology College of Design

- **resolution and data rates**
  - lower data rates for compression formats
- **audio formats**
  - multichannel & WFS, 3D acoustics in general
  - object-based audio
- **production environments**
  - online collaboration/musicianship
  - machine musicianship
- **software**
  - machine listening: music recommendation systems, etc.
  - signal- and user-adaptive audio production software
  - computer-aided editing, composition, and performance systems
  - interactive and creative audio consumer software

introduction

current trends & developments

- **resolution and data rates**
  - lower data rates for compression formats
- **audio formats**
  - multichannel & WFS, 3D acoustics in general
  - object-based audio
- **production environments**
  - online collaboration/musicianship
  - machine musicianship
- **software**
  - machine listening: music recommendation systems, etc.
  - signal- and user-adaptive audio production software
  - computer-aided editing, composition, and performance systems
  - interactive and creative audio consumer software

introduction

current trends & developments

Georgia Tech Center for Music Technology
College of Design

- **resolution and data rates**
  - lower data rates for compression formats
- **audio formats**
  - multichannel & WFS, 3D acoustics in general
  - object-based audio
- **production environments**
  - online collaboration/musicianship
  - machine musicianship
- **software**
  - machine listening: music recommendation systems, etc.
  - signal- and user-adaptive audio production software
  - computer-aided editing, composition, and performance systems
  - interactive and creative audio consumer software

introduction

current trends & developments

- **resolution and data rates**
  - lower data rates for compression formats
- **audio formats**
  - multichannel & WFS, 3D acoustics in general
  - object-based audio
- **production environments**
  - online collaboration/musicianship
  - machine musicianship
- **software**
  - machine listening: music recommendation systems, etc.
  - signal- and user-adaptive audio production software
  - computer-aided editing, composition, and performance systems
  - interactive and creative audio consumer software

introduction

relation to class context

Georgia Tech Center for Music Technology College of Design

- in this class, we will learn the basics of
  - **digitizing** an analogue signal
  - **transforming and analyzing** a digital signal
  - **processing** a digital signal
  - **applying standard effects** to a digital signal
  - **encoding and decoding** a digital signal