A Virtual Dancer "Cindy"
Interactive Performance of a Music-controlled CG Dancer

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1. Introduction

Interactive Performance

- Multimodal Interaction
  Virtual dancer enables two players to interact through music and 3D computer animation (auditory and visual information)

- Our Goal
  Achieve a new mode of interaction in which CG and music are closely integrated by a LCC

Previous Performance

- Interactive system between a player and a LCC
  Interaction between human players was not considered

- Conventional Jam Session
  Musical interaction between players is essential
  Exchange of auditory information and auxiliary visual information (gestures)

Virtual Dancer "Cindy"

- Enhance visual interaction in a jam session
- Provide two players with more expressive way to communicate
- Two players
  Choreograph Cindy together by their musical improvisation in real time
  Play different roles in choreographing
- Cooperation between players is important to make music good and the dance full of variety

2. Interactive Performance of Cindy

Overview
- Two players improvise on different musical instruments
- Cindy is controlled and choreographed by musical performance
- Cindy does not move in time to the music autonomously

Player A (Drums)

- Seven kinds of drum-sounds
  Bass Drum (BD)
  Snare Drum (SD)
  Low Tom (LT)
  Middle Tom (MT)
  High Tom (HT)
  Crash Cymbal (CR)
  Ride Cymbal (RI)

- Each is mapped to a different dance motion
- Control the timing of each dance motion by the onset time of the drum-sound

Player B (Guitar, Piano, etc.)

- Parameters periodically derived from performance
  NumNotes: The number of notes
  AvePitch: Average pitch
  ChordMeas: Whether a single note or chord is played

- Switch six predefined sets of mapping between drum-sounds and dance motions
  1) Normal motions (Default)
  2) More cheerful motions (NumNotes: Many)
  3) Quiet and small motions (NumNotes: Few)
  4) Hand-raising motions (AvePitch: High)
  5) Dynamic motions (ChordMeas / NumNotes: Large)
  6) More dynamic motions (ChordMeas / NumNotes: Larger)

Mapping between drum-sounds and motions

Player A

RI
CR
HT
MT
LT
SD
BD

Drum-sounds

Motion mapping 1

Player B

Waiting pose

Motion

Waiting pose

Motion mapping 2

Waiting pose

Motion mapping 6
3. Three Kinds of Interaction

- Interaction between players through music
  - Musical interaction
  - Improvise while reacting to each other’s performance
  - Cooperatively try to make music good

- Interaction between each player and Cindy
  - Direct interaction (Player A)
    - Determines the timing of dance motion
    - Directly changes Cindy while looking at the dance motion
    - Cannot determine the motion mapped to each drum-sound

- Interaction between each player and Cindy
  - Indirect interaction (Player B)
    - Switches the mapping set
    - Indirectly changes Cindy while confirming the change of the mapping by looking at dance motions made by A
    - Cannot make Cindy move by himself

- Interaction between players through Cindy
  - Cooperative interaction
  - Choreograph Cindy cooperatively to make the dance full of variety
    - Player A tries to change motions in a manner appropriate to the current mapping that player B selects
    - Player B tries to change the mapping in a manner appropriate to the way that player A currently plays

4. Implementation

- Distributed Computing Environment
  - SGI Indigo2 Extreme x 2
  - Ethernet
  - MIDI (Musical Instrument Digital Interface)
  - RMCP (Remote Music Control Protocol)

  Communication protocol on the UDP/IP based on the server-client model
  MIDI data of players’ performances are broadcast as RMCP packets

  Allocate different tasks on several computers
  Achieve good load-balancing

- RMCP Servers and Clients

  1. Take each player’s performance as input
  2. Output sounds of players’ performance
  3. Analyze player B’s performance
  4. Display Cindy on 3D computer animation

5. Experimental Results

- Conditions
  - Improvised music such as rock, pop, and fusion
  - Player A played the drums on a synthesizer keyboard
  - Player B played a melody or chords on a MIDI guitar

- Results
  - Choreographed Cindy directly and indirectly by improvising
  - To vary Cindy’s motions they tended to make performance more varied than performance in a conventional session
  - Interacted visually to change the motions cooperatively

6. Video Explanation
6. Conclusion

Summary

- Interactive performance system in which two players and Cindy interact through music
- Three kinds of interaction
  1. Interaction between players through music
  2. Interaction between each player and Cindy
  3. Interaction between players through Cindy
- Implemented on distributed workstations
- Achieved an interesting new interaction that cannot be achieved through music alone

Design of Interactive Performance

- Avoid mismatches between media and keep harmony
- Perform three kinds of interaction simultaneously without feeling disharmonious
  Use the drums, which mainly maintain the rhythm in music, and the guitar, which characterizes the mood in music.
  In the direct interaction determining the timing of dance, the indirect interaction determines the mood.
- Consider harmony between the dance motions and the mood of the improvised performance
  Cheerful motions are selected when performance is cheerful and quiet motions are selected when performance is quiet.

Future Work

- Design other interactive performances
  Interactive performance system for three or more players for other LCCs
- Remote interactive performance
  Our implementation facilitates the use of the system in settings where the players are not in the same physical location
- Interactive performance via Internet