Andrew McPherson

CIFellow, Drexel University

Department of Electrical & Computer Engineering

CIFellows Project:

"Understanding and Shaping Creative Musical Expression Through Computing"

Massachusetts Institute of Technology

S.B. Electrical Engineering & Computer Science
S.B. Music
M.Eng. Electrical Engineering

University of Pennsylvania

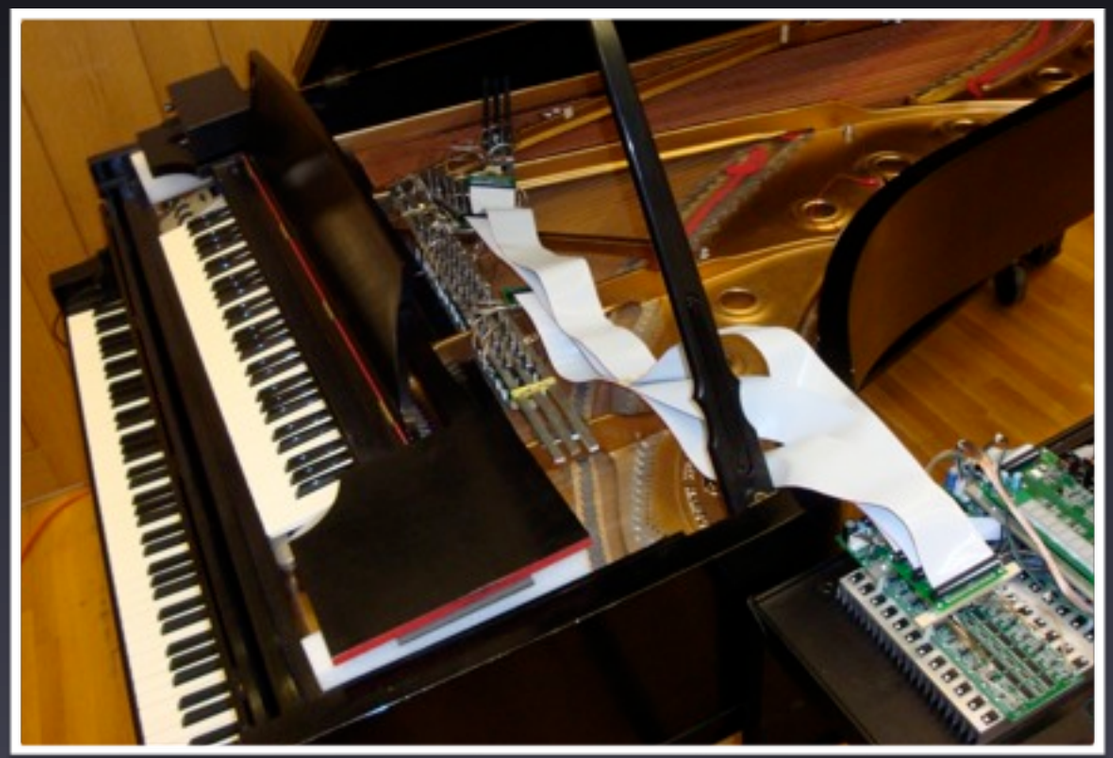
Ph.D. Music Composition

Drexel University

CIFellowship
Department of Electrical & Computer Engineering

The road to a CIFellowship...

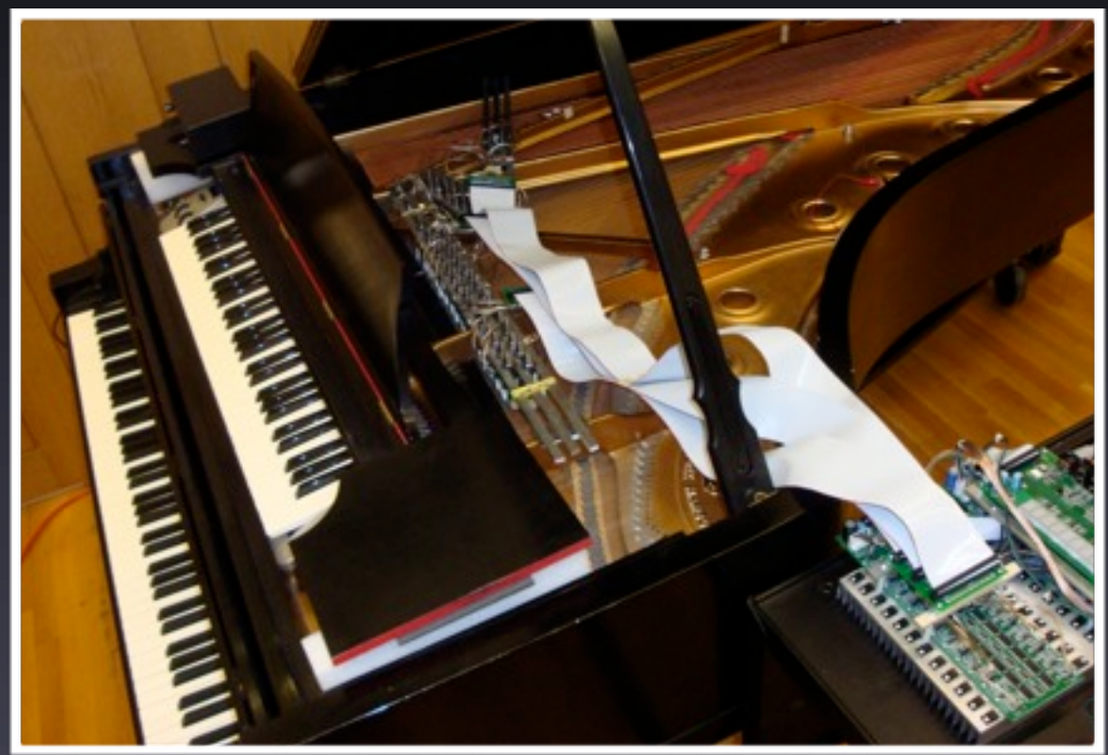
Ph.D. dissertation: *"The Magnetic Resonator Piano: Electronic Augmentation of an Acoustic Grand Piano"*



Goal: bridge the gap between music and computing...

The road to a CIFellowship...

Ph.D. dissertation: *"The Magnetic Resonator Piano: Electronic Augmentation of an Acoustic Grand Piano"*

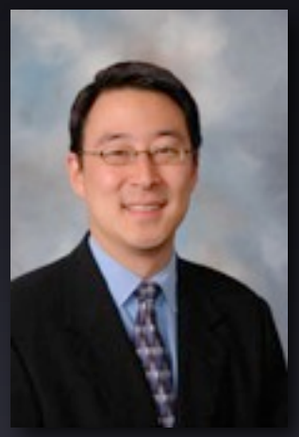


Goal: bridge the gap between music and computing...

... but where is the natural home for this research?

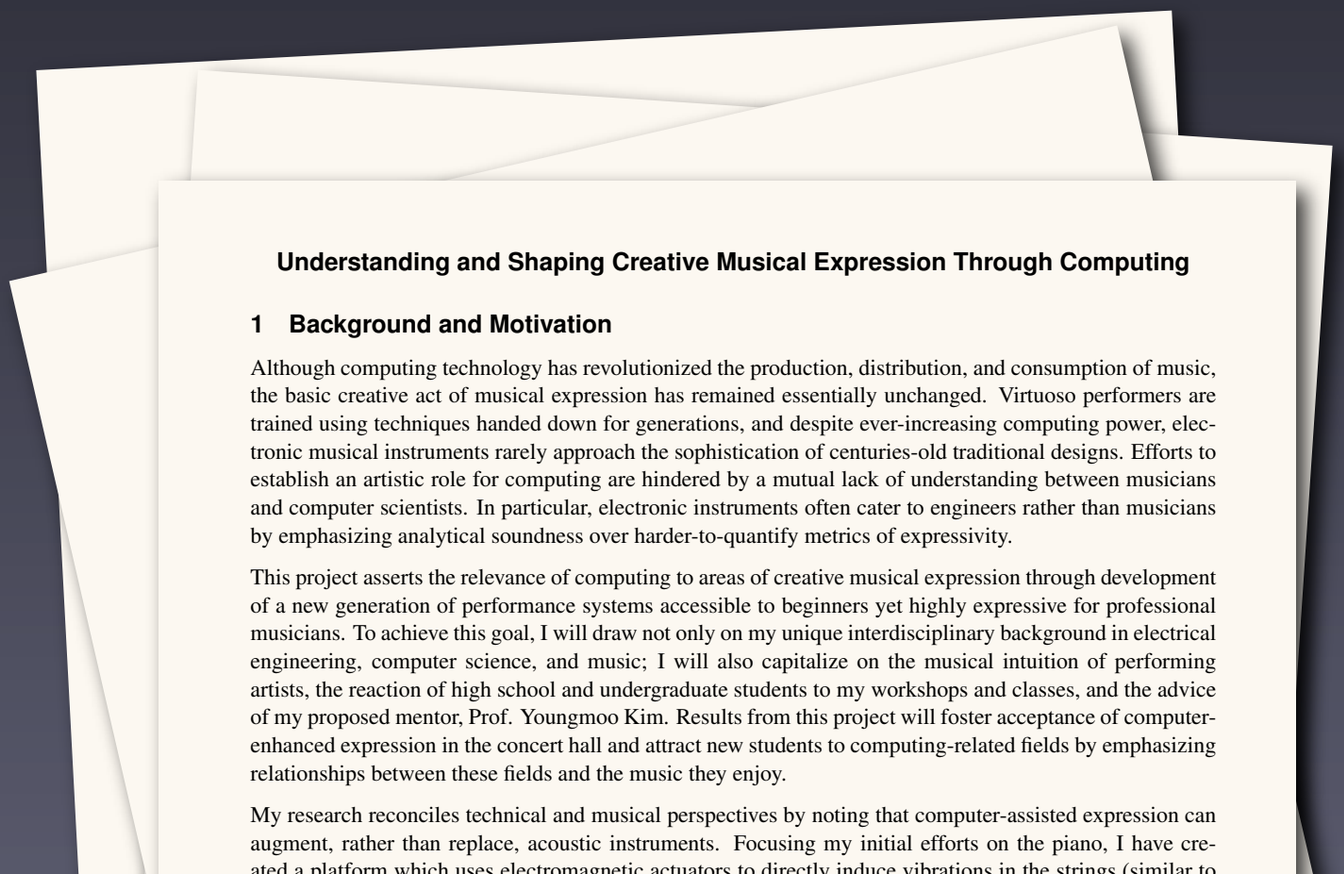
The road to a CIFellowship...

Finding a mentor:



Youngmoo Kim
Music & Entertainment Technology Laboratory

Preparing the application:



Understanding and Shaping Creative Musical Expression Through Computing

1 Background and Motivation

Although computing technology has revolutionized the production, distribution, and consumption of music, the basic creative act of musical expression has remained essentially unchanged. Virtuoso performers are trained using techniques handed down for generations, and despite ever-increasing computing power, electronic musical instruments rarely approach the sophistication of centuries-old traditional designs. Efforts to establish an artistic role for computing are hindered by a mutual lack of understanding between musicians and computer scientists. In particular, electronic instruments often cater to engineers rather than musicians by emphasizing analytical soundness over harder-to-quantify metrics of expressivity.

This project asserts the relevance of computing to areas of creative musical expression through development of a new generation of performance systems accessible to beginners yet highly expressive for professional musicians. To achieve this goal, I will draw not only on my unique interdisciplinary background in electrical engineering, computer science, and music; I will also capitalize on the musical intuition of performing artists, the reaction of high school and undergraduate students to my workshops and classes, and the advice of my proposed mentor, Prof. Youngmoo Kim. Results from this project will foster acceptance of computer-enhanced expression in the concert hall and attract new students to computing-related fields by emphasizing relationships between these fields and the music they enjoy.

My research reconciles technical and musical perspectives by noting that computer-assisted expression can augment, rather than replace, acoustic instruments. Focusing my initial efforts on the piano, I have cre-
ated a platform which uses electromagnetic actuators to directly induce vibrations in the strings (similar to

Lots of drafts
Multiple mentor meetings

Big picture / details
Fit everything in 2 pages!

frequency

chroma features

interface

control

envelope

waveform

amplitude

latency

spectral centroid

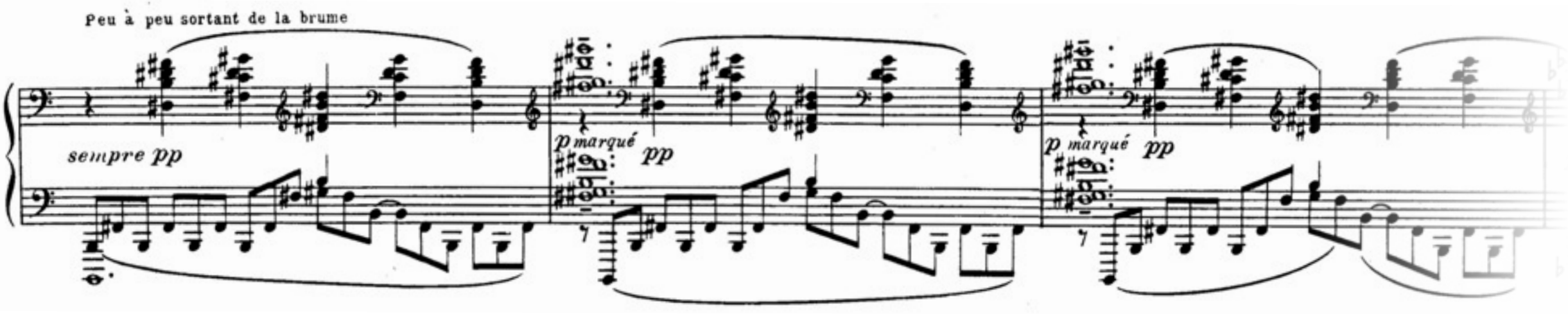
dimensionality

periodicity

timing

cepstrum

bandwidth



pitch

rhythm

tempo

instrument

phrasing

character

articulation

interpretation

expression

dynamics

technique

shape

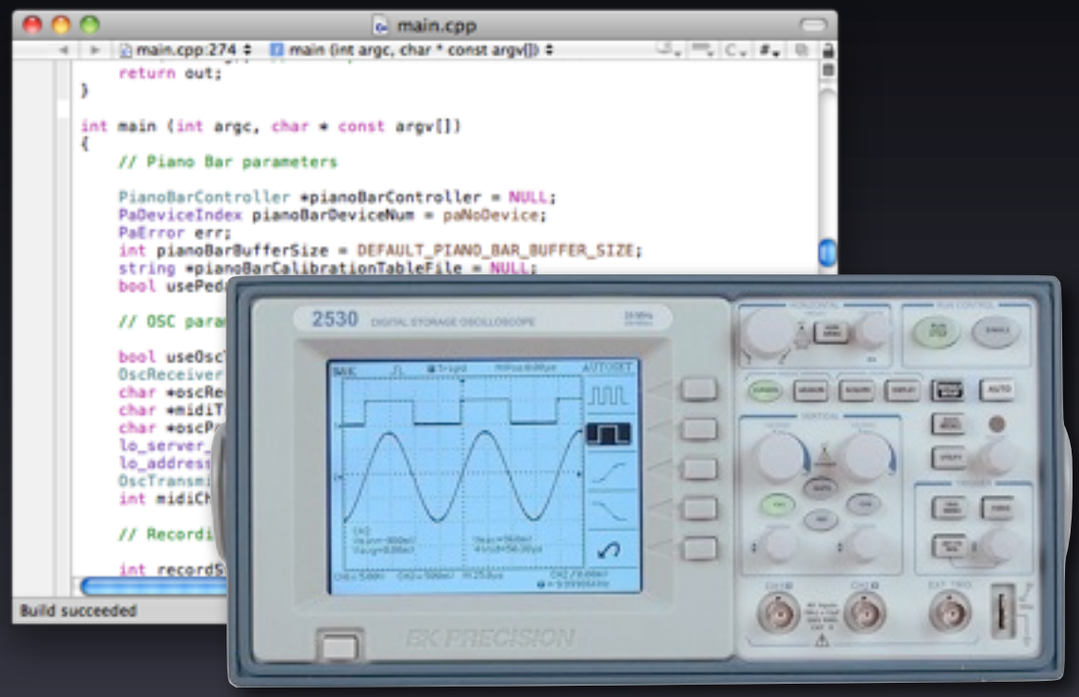
timbre

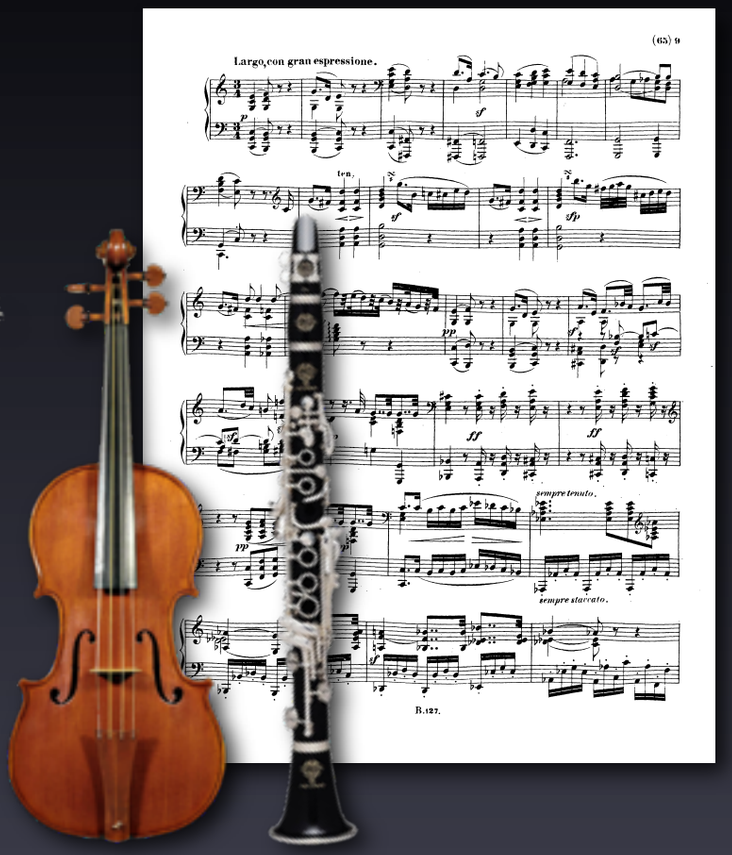
style

“The sound of the oboe I achieve with rounded, hooked-under, and, as it were, bony fingers, in poco legato. The flute ... whenever possible, I play every note with the help of a separate arm movement. The bassoon ... the touch is finger-staccato. The noble, full, somewhat veiled, ‘romantic’ sound of the horn demands a loose arm and a flexible wrist.”

- Alfred Brendel, from *Musical Thoughts and Afterthoughts* (1976)

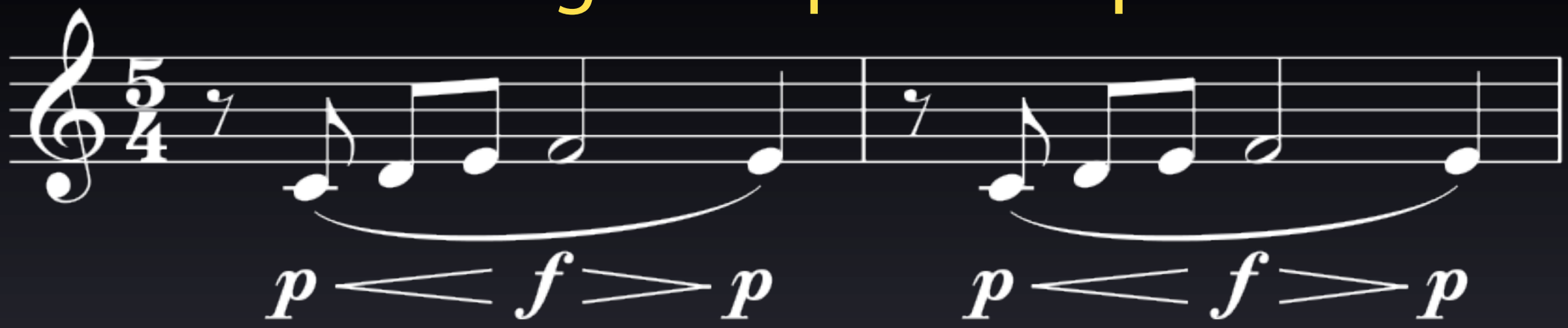
Fellowship goals:



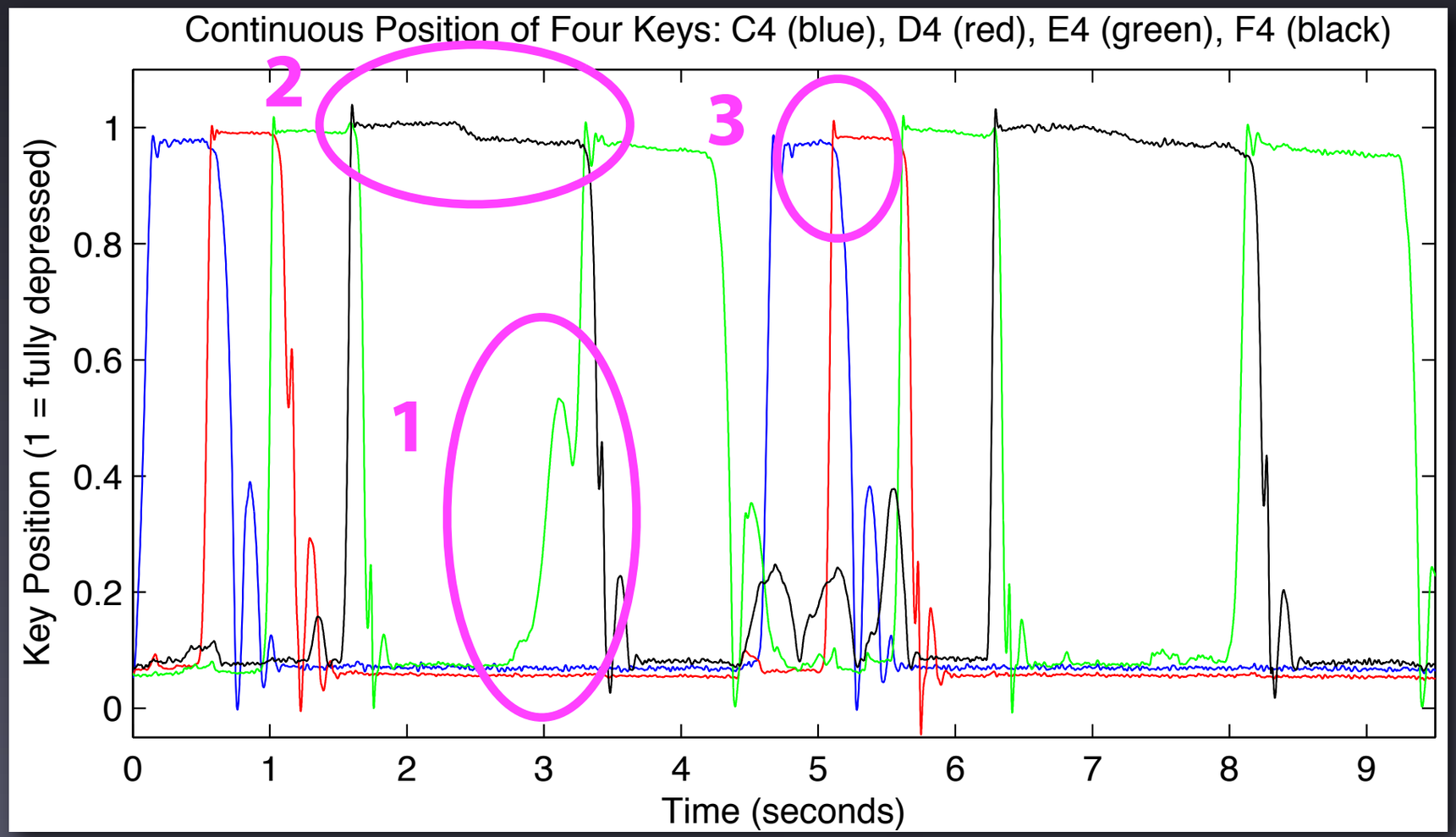


1. Quantitative understanding of creative expression
2. Develop computational tools to support creativity
3. Education and outreach activities

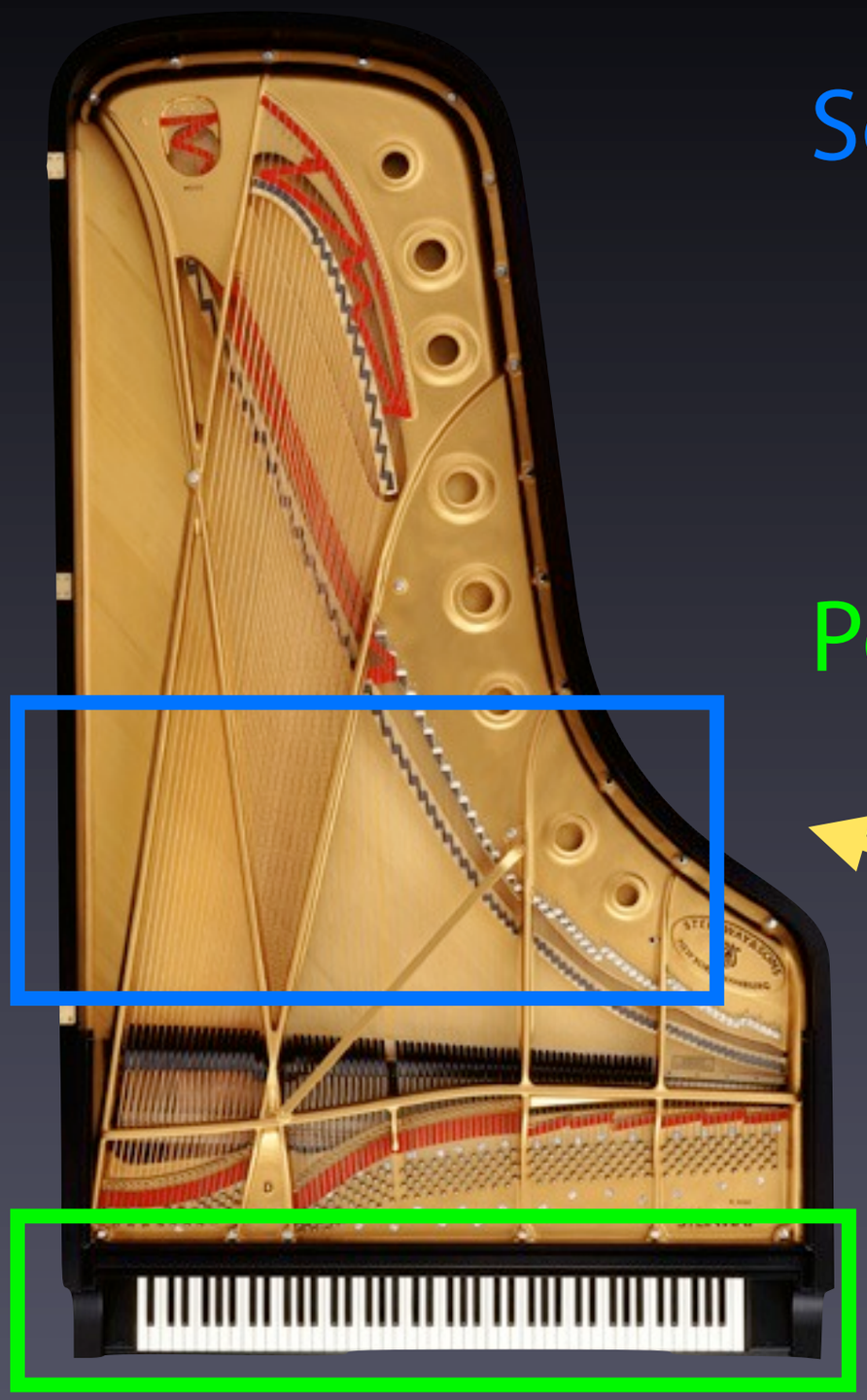
Decoding an expressive performance



1. Shape of key presses
2. Aftertouch (key pressure)
3. Connection between notes



The mapping problem



Sound production parameters:

- Frequencies
- Amplitudes
- Waveforms (spectra)
  - All parameters are time-varying

Performance features:

- Key and pedal position
- Key velocity and acceleration
- Higher-level inferred features
  - Key press shapes
  - Multi-key patterns

Map from gesture to sound

Fellowship experience

(I love my CIFellowship!)

Funding supports a wide range of activities:

- Conference travel
- Equipment expenses
- Musician user studies
- Student outreach

Opportunities for cross-institutional collaboration

CURTIS INSTITUTE OF MUSIC

Penn

PRINCETON UNIVERSITY

Mentor relationship has been extremely valuable

Classroom teaching

New Course Spring 2010

ECE 121: Introduction to Entertainment Engineering

Instructors: Prof. Youngmoo Kim & Dr. Andrew McPherson
Time: T/Th 12:30-1:50PM
Location: Curtis 451

Digital technologies have revolutionized the world of entertainment. We have nearly limitless music, movies, and interactive media at our finger-tips, which we can watch and listen to anytime and anywhere on iPods and other portable digital devices.

This survey course will focus on four prevailing entertainment media: music, images, video, and games. We will explore how each medium is represented digitally and reveal the technologies used to capture, manipulate, and display such content. The goal of this course is to provide students with technical literacy for using digital media and a fundamental understanding of the technologies allowing them to be informed consumers and creators of current and future entertainment content.

Open to students of all majors, with no prerequisites.

Note: For Spring 2010, please register for ECES-490-001 (Intro to Entertainment Engineering)

Thank you!