David K. Grunberg

Contact Information

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Research Interests

Noise-Robust Music-Information Retrieval: Humans often listen to music in noisy environments. Music-Information Retrieval algorithms that function accurately in these environments can thus be reliably used on more of the music that human users hear, allowing people better interact with and enjoy such music.

Musical Robots: While robotic accompaniment is becoming more common in music performances, many such robots can only reproduce pre-recorded gestures and are unable to respond to changes in the music. Algorithms which enable robots to listen to and understand musical audio allow them to perform with humans in a more flexible and adaptable manner.

Music-Information Retrieval for Education: Music-Information Retrieval algorithms can be used to process musical performances and extract useful information. This information can then be used to provide educational content for human users, enabling them to better understand and enjoy the performances.

Education

Drexel University, Philadelphia, Pennsylvania, USA

Ph.D., Electrical Engineering, December 2014

- Dissertation Topic: "Developing a Noise-Robust Beat Learning Algorithm for Music-Information Retrieval"
- Advisor: Youngmoo E. Kim

M.S., Electrical Engineering, December, 2011

B.S., Electrical Engineering, June, 2010

Honors and Awards

National Science Foundation Graduate Research Fellowship (2010-2013)

Eta Kappa Nu (HKN) electrical and computer engineering honor society

Tau Beta Pi (TBP) engineering honor society

Graduated magna cum laude

Drexel Presidential Scholarship

Academic Experience

Drexel University: Graduate Research Assistant **Summer 2010 - present**
Performed research on multiple Music-Information Retrieval topics and took numerous graduate-level classes in signal processing and machine learning.

Drexel University: Student Lecturer - Summer Music Technology **Summer 2007 - present**
Designed lessons that used Music-Information Retrieval algorithms and musical interfaces to motivate science, technology, engineering and math (STEM) concepts, and taught those lessons to high school students.

Czech Technical University: Visiting Research Assistant **Summer 2012**
Worked at the Czech Technical University on a project involving the automatic detection of periodic motion in images. This project utilized state-of-the-art motion tracking algorithms which were developed at that institution.

Drexel University: Teaching Assistant **Spring 2012**
Lead students through projects and study materials in the course 'DSP For Sound and Hearing' in the Electrical and Computer Engineering Department at Drexel University, as well as graded homework and exams.

Drexel University: Senior Design **Fall 2009 - Spring 2010**
Developed the score-tracking portion of a system that determines the position of an orchestra in a score and then presents contextually relevant annotations in real-time on mobile devices.

Drexel University: Undergraduate Research Assistant **Fall 2006 - Spring 2010**
Developed Music-Information Retrieval algorithms to enable robots to respond to music.

Korea Advanced Institute of Science and Technology: Research Co-op **Spring - Summer 2009**
Worked at the Hubo development lab at the Korean Advanced Institute for Science and Technology (KAIST). Participated in multiple projects, including documenting the Hubo system and testing the robot's CAN bus.

Computer Skills

Programming Languages
C, Matlab

Multimedia Production
PureData, iMovie, GarageBand, Camtasia

Presentation
LaTeX, Apple iWork Suite, Microsoft Office Suite

Operating Systems
Mac OSX, Linux (Ubuntu)

Publications

D. Grunberg, "Music Information Retrieval in Environments Containing Acoustic Noise," in *Proceedings of the ACM International Conference on Multimedia (doctoral symposium), Orlando, USA*, 2014.

D. Grunberg, and Y. Kim, "Rapidly Learning Musical Beats in the Presence of Environmental and Robot Ego Noise," in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems, Chicago, USA*, 2014. pp. 1914-1919.

M. Prockup, D. Grunberg, A. Hrybyk, and Y. Kim, "Orchestral Performance Companion: Using Real-Time Audio to Score Alignment," *IEEE MultiMedia*, vol. 20, no. 2, pp. 52-60, April-June 2013.

A. Batula, M. Colacot, D. Grunberg, and Y. Kim, "Using Audio and Haptic Feedback to Detect Errors in Humanoid Musical Performances," in *Proceedings of the International Conference on New Interfaces for Musical Expression, Daejeon, South Korea*, 2013. pp. 295-300.

D. Grunberg, A. Batula, E. Schmidt, and Y. Kim, "Affective Gesturing with Music Mood Recognition," in *Proceedings of the International Conference on Humanoid Robotics, Osaka, Japan*, 2012. pp. 343-348.

D. Grunberg, A. Batula, E. Schmidt, and Y. Kim, "Synthetic Emotions for Humanoids: Perceptual Effects of Size and Number of Robot Platforms," *Journal of Synthetic Emotions: Special Issue on Music, Robots, and Emotion*, vol. 3, no. 2, pp. 68-83, July-December 2012. (*Invited Paper.*)

A. Batula, B. Morton, R. Migneco, M. Prockup, E. Schmidt, D. Grunberg, Y. Kim, and A. Fontecchio, "Music Technology as an Introduction to STEM," in *Proceedings of the 2012 ASEE Annual Conference, San Antonio, USA*, 2012.

D. Grunberg, D. Lofaro, P. Oh, and Y. Kim, "Robot Audition and Beat Identification in Noisy Environments," in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems, San Francisco, USA*, 2011. pp. 2916-2921.

Y. Kim, D. Grunberg, A. Batula, D. Lofaro, J. Oh, and P. Oh, "Enabling Humanoid Musical Interaction and Performance," in *Proceedings of the International Conference on Collaboration Technologies and Systems, Philadelphia, USA*, 2011. pp. 212-215.

Y. Kim, A. Batula, R. Migneco, P. Richardson, B. Dolhansky, D. Grunberg, B. Morton, M. Prockup, E. Schmidt, and J. Scott, "Teaching STEM Concepts Through Music Technology and DSP," in *Proceedings of the 14th IEEE Digital Signal Processing Workshop and 6th IEEE Signal Processing Education Workshop, Sedona, USA*, 2011. pp. 220-225.

D. Grunberg, R. Ellenberg, I. Kim, J. Oh, P. Oh, and Y. Kim, "Development of an Autonomous Dancing Robot," *International Journal on Hybrid Information Technology*, vol. 3, no. 2, pp. 33-43, April 2010.

Y. Kim, A. Batula, D. Grunberg, D. Lofaro, J. Oh, and P. Oh, "Developing Humanoids for Musical Interaction," in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems, Taipei, Taiwan*, 2010. pp. 36-43.

R. Ellenberg, D. Grunberg, P. Oh, and Y. Kim, "Using Miniature Humanoids as Surrogate Research Platforms," in *Proceedings of the International Conference on Humanoid Robotics, Paris, France*, 2009. pp. 175-180.

D. Grunberg, R. Ellenberg, P. Oh, and Y. Kim, "Creating an Autonomous Dancing Robot," in *Proceedings of the International Conference on Convergence and Hybrid Information Technology, Daejeon, South Korea*, 2009. pp. 221-227.

D. Grunberg, R. Ellenberg, Y. Kim, and P. Oh, "From RoboNova to HUBO: Platforms in Robot Dance," in *Proceedings of the International Conference of Advanced Humanoid Robotics Research, Incheon, South Korea*, 2009. pp. 19-24.

R. Ellenberg, D. Grunberg, P. Oh, and Y. Kim, "Exploring Creativity Through Humanoids and Dance," in *Proceedings of the International Conference on Ubiquitous Robotics and Ambient Intelligence, Seoul, South Korea*, 2008.

Activities

Pianist and Musician
I have studied and performed music since childhood. Throughout high school and college, I continued with my lessons and my study.

Write 1/Sub 1
I am part of a fiction writing community called 'Write 1/Sub 1' in which each member attempts to write and submit at least one story per month.I have consistently met or exceeded my goal. To further my skills in this area, I regularly attend conferences focused on writing and publishing.