



IU BLOOMINGTON

# EMERGING AREAS OF RESEARCH

## Abstract Template -- Due June 30, 2017

Title of initiative to be proposed:

Music Tutoring Systems

Name of lead PI, with title, department/school:

Prof. Christopher Raphael, School of Informatics and Computing

Key team member names and departments/schools (up to 10 names):

Prof. Gretchen Horlacher, Jacobs School of Music; Assoc. Prof. David Crandall, School of Informatics and Computing; Assoc. Prof. David Cartledge, Jacobs School of Music; Assoc. Prof. Pete Miksza, Jacobs School of Music; Asst. Prof. Minje Kim, School of Informatics and Computing

Description of area to be proposed. What constitutes this area of research or creative activity as emerging?  
(Word limit=500)

Online technology has brought education to the masses in an unprecedented way, with services like Coursera and Udacity reaching hundreds of thousands of people. These services give people in even the most remote areas access to the world's great universities and professors, and dramatically extend the reach of educational institutions across the globe. Unfortunately, while current online education technologies work well for subjects like computer science, it is not obvious how to effectively teach skills like music and art where even beginning instruction requires regular and immediate interaction with a human expert. As a consequence, rural and other disadvantaged populations cannot receive instruction proven to increase learning, persistence, creativity, and quality of life. Additionally, education institutions with premiere expertise in arts and humanities (notably Indiana University) cannot extend their outreach via online technologies. We need to develop advanced new technology that can monitor a student's progress in learning a skill in real time, using minimal equipment (e.g. a simple laptop or smartphone) to do the observation, and automatically give feedback without constant manual effort of a human instructor. The proposed project would take a first but important step in this direction, developing the technology required to automatically monitor a student's progress in learning to play a musical instrument. It leverages IU's unique combination of interdisciplinary strengths in Music and Computer Science to develop ambitious new technology that could transform music instruction, dramatically extending the potential impact of the Jacobs School to millions of people online.

Our specific focus is a Music Tutoring System -- a program designed to teach a musical instrument. The challenge involves marrying the two disparate realms of recognition and music pedagogy. To succeed we must first sense the student's playing, detecting when the pitches, intonation, rhythm, fingerings, etc. are correct (we will limit our domain to scenarios where "correctness" is meaningful). Our approach will fuse both audio and video data since instrumental teaching usually involves aspects that must be heard, such as dynamics, and those that must be seen, such as the choice of fingering. Here we

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