FY11 Innovations in Teaching with Technology Awards: Integrated 3D Curriculum for Engineering and Human Modeling

FY11 Innovations in Teaching with Technology Awards

<table>
<thead>
<tr>
<th>Proposal Title:</th>
<th>Integrated 3D Curriculum for Engineering and Human Modeling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigators:</td>
<td>Tim Marler</td>
</tr>
<tr>
<td>Org Unit:</td>
<td>College of Engineering</td>
</tr>
<tr>
<td>Department(s):</td>
<td>CCAD</td>
</tr>
<tr>
<td>Funding Awarded:</td>
<td>$25,050</td>
</tr>
</tbody>
</table>

Teaching the fundamentals of human modeling can be challenging as a result of the complexities of optimization, computer science, programming, 3-dimensional robotics, and interface design. These complexities are compounded in the context of the Virtual Soldier Research (VSR) program, where steep learning curves must be overcome quickly in order to respond to practical deliverables for funding partners. This necessity applies to staff, graduate students, undergraduates, and high school interns. There is little leeway for time spent purely on education; there must be practical results as well. This challenge has fostered a seedling educational program that provides fast, effective, and practical hands-on education. This initial program is required of all new VSR employees. It not only provides a tool for quickly training new employees but also provides the basis of a truly multi-disciplinary course on computational human modeling.

We propose leveraging the success at VSR; coordinating collaboration between the Mechanical and Industrial, Computer Science, and Civil Engineering Departments; and formalizing a computational human modeling course. However, the novelty of the proposed work extends beyond interdisciplinary collaboration and structured new curriculum. This proposal also explores the advantages of 3-dimentional education, whereby complex systems like the human skeletal structure could be studied with 3-dimentional projections in the classroom. Even with basic engineering courses, actually visualizing and understanding systems in 3D space is challenging. Finally, the proposed work will explore teaching within the context of a large active lab. VSR has had substantial success implementing the old idea of a one-room classroom, whereby approximately 25 students and staff work in the same room with low cubical walls (both literally and figuratively). This provides a thriving problem-solving environ!
ment, in which students and staff of varying skill levels interact and teach each other on a regular basis.

Although the proposed course would entail typical time spent in the classroom, all students would rotate through the VSR lab. Although this proposal entails significant challenges with respect to collaboration and interaction, it inherently hedges the risks typically associated with educational exploration. First, the kernel for this work is an existing short course, which will be extended. If this aspect of the work were the only successful aspect, there would still be substantial value added to the College of Engineering, especially considering the relatively new interest in human modeling within the college. Secondly, the use of 3D visualization is proven to increase the effectiveness of educational programs. Hardware obtained under this program will have a variety of potential applications above and beyond the proposed work. Finally, despite potentially challenging logistics of integrating a course with a lab, any exposure to a large research operation provides valuable experience to undergraduate and graduate students alike.

The proposed work will take place over a nine month period: one semester for preparation and one semester for implementation. The first step would entail general course design. The consequent intermediate level course would center around programming projects regarding predicting human posture, motion, and muscle activity. Concurrently, it would cover the basics of programming, robotics, optimization, human factors (software interface design), and multi-scale modeling. The primary intent of the course is to teach students to develop computational methods for digital human modeling, as well as to use existing human modeling software for conducting human simulation studies. This initial step would be completed within two months and would be followed by the development of a more detailed syllabus. The second stage of the work would entail implementation as an actual course, taking advantage of 3D capabilities within the classroom as well as integration with the VSR lab.

The objectives of the propose course would be multi-faceted. First, the primary objective is to enhance the effectiveness of human modeling education. However, concurrently, the education focus points towards the underlying fundamentals of programming, optimization, human factors, and scientific study of human performance. Despite the apparent complexity of the topic, we have shown that even high school interns can learn this material quickly and to the point of potential practical application if the material is taught properly. The education must involve ownership of small feasible projects, mentorship from various co-workers, and visible practical applications (i.e. mature human modeling software).

A course curriculum that builds on itself and culminates in a practical tool is inherently engaging, especially when a visual element is involved. Affording the students
**Improve student learning?**

Ownership of capabilities that can be integrated in mature software (as provided by VSR) also increases the interest of the students. 3-dimensional presentation of the human modeling capabilities further engages students, allowing them to conceptualize otherwise confusing ideas. Finally, integration with a thriving research and development organization demonstrates the significance of the students work and thus fosters additional interest.

Although studies have been published demonstrating the effectiveness of 3D capabilities for education and visualization of complex concepts in general, we propose monitoring the effectiveness of eth proposed educational ideas as well. Following the initial nine months, which will culminate in a value-added course structure and curriculum, we propose conducting formal studies in collaboration with the Education Department.

**What resources will you need?**

- **Hardware:**
  - DLP3D ready projector for classroom - $800
  - 30 Shutter glasses ($70 per pare) - $2100
  - Lap top with quadro card - $2500

- **Staff and Student time:**
  - PI and Co-PI development time 1 month each - $23,000
  - Graduate TA 1 year - $35,000

**Rough estimate of costs**

Please see above.

**IT Support Information**