MMSIC Lab Manager Presents at IOM's Global Forum

Mr. Geoffrey Miller, Lab Manager and Research Scientist at TATRC's Medical Modeling and Simulation Innovation Center (MMSIC), was invited to present to the Global Forum on Innovation in Health Professional Education, Improving Health Professional Education and Practice through Technology, at the National Academies of Sciences, Institute of Medicine, in Washington DC on 16 November. At this forward-thinking forum, Mr. Miller presented on the future of Autonomous Intelligent Mentoring (AIM): Applying Game Technology to Advance Medical Education. Mr. Miller began this research and technology development at Eastern Virginia Medical School, and is continuing to pursue the development of these technologies to advance and augment education and assessment of health professionals.

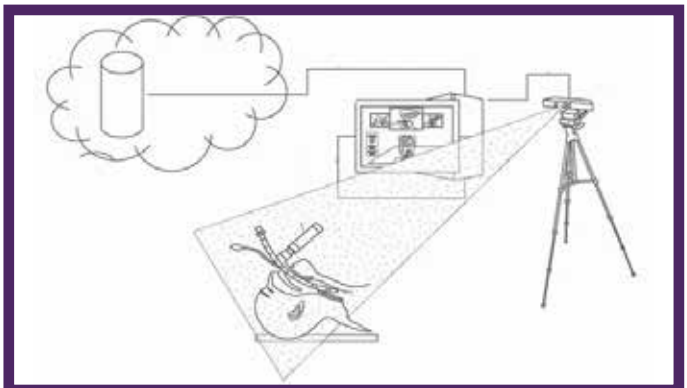

Figure 1. Schematic representation of the AIM Figure 1. Schematic representation of the AIM concept. A 3D computer vision system observes the procedure and feeds the data to the computer, which then compares the observation with the mastery performance model and provides feedback.

The main goal of any training program is to prepare trainees to perform effectively on post-training tasks in a real-world setting. Ideally, to achieve this goal, learners must have access to expert instruction, assessment and individualized feedback. This is frequently very difficult to provide on an individualized level, leaving many learners without this valuable experience. More recently though, computer vision systems, machine learning and artificial intelligence are demonstrating great promise to ensure that every learner, has equal access to expert instruction, assessment and performance improvement feedback, unique to their particular learning needs.

The importance of deliberate and repetitive practice and feedback are well recognized features of medical simulation which lead to effective learning[1,2]. To provide adequate opportunity of these key features, learners must have access to appropriate simulation devices, equipment, faculty mentoring, expertise and feedback and individualized time to acquire a designated skill to the defined level of competence or mastery. Though this model is achievable, it comes at a high cost in terms of availability of devices, equipment, faculty expertise and time. In some cases, this limits the opportunity for learners to have adequate, individualized opportunity to achieve desired performance outcomes or the opportunity to receive "expert" mentoring. Further, as clinical demands increase on medical educators, their availability to observe, mentor students and provide meaningful feedback is becoming more difficult, especially at the individualized level. Finally, faculty observations of clinical procedural skills mainly rely on subjective criteria regarding the actual precision of real-time human performance metrics. The objective measurement of these human performance metrics is missing in terms of simulator(s) and faculties' ability to provide feedback for performance improvement of procedural skills.

The AIM concept seeks to 1) develop a low-cost solution, focused on the measurement of human performance related to specific real-time, 3D psychometric measurements of clinical procedural skills (Figure 1), 2) improve and increase opportunities for individual, independent, deliberate practice, with real-time, objective assessment and expert feedback for procedural skill acquisition, 3) collect and curate a library of human clinical procedural skill performance models using a common standard, open source approach, and 4) provide universal access to expert instruction with individualized autonomous feedback for learners and performance analytics for instructors.

Initial research using the AIM concept addresses the need to model expertise and provide procedural mentorship and training, and objective performance feedback regarding the physical performance during endotracheal intubation, which cannot be measured by current airway simulators. The AIM concept leverages off-the-shelf computers and the Microsoft™ Kinect™ motion capture devices, to acquire real-time, 3D time-space objective measurement of human performance, compared to a master performance model of expected psychomotor skill. The master performance model was developed by recording the performance of acknowledged expert airway management clinicians and developing an aggregate model (Figure 2), which is mapped against the learner to provide corrective performance assessment, and individualized corrective feedback.

Mr. Geoff Miller addressed the IOM November 14.

These expert clinical procedural performance models are also essential to efforts investigating medical robotics and medically intelligent/autonomous systems for the military. These systems

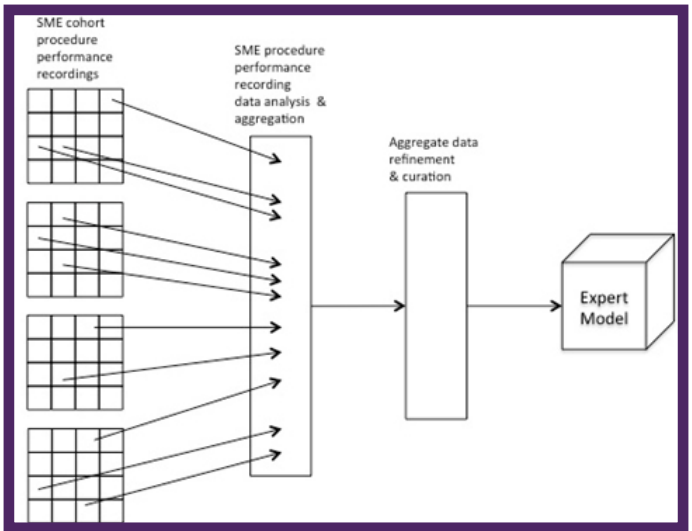

Figure 2. Mastery performance models are created by recording a minimum of 10 expert clinicians over the course of 10 or more concurrent procedural performances. These recordings focus on 3D tracking of human performance and instrument manipulation to ensure construct validity and variations of technique. Measurements are calibrated to fit a common scale, recordings are aggregated and refined to become the master model, accounting for technique variations which have no bearing on outcome.

will require libraries of performance models to begin to teach these future systems "how to perform" like expert clinicians. TATRC's labs are actively investigating these concepts and lines of research in current and future projects.

The AIM concept is a first step in providing comprehensive, real-time interactive expert instruction including active visual cues, and dynamic individualized feedback to users. The current version of the AIMS intubation model has successfully demonstrated effectiveness on a wide array of airway simulators from a variety of simulator manufacturers. Mr. Geoff Miller notes, "we are getting much closer to ensuring that every learner has equal access to expert teaching, assessment and feedback, no matter when or where they are training. The use of these technologies may provide an invaluable resource to health professions and instructors across the entire Military Health System, and to future military medical robotics and medically intelligent systems development."

For more information on the AIM concept, please contact Mr. Miller at geoffrey.t.miller4.civ@mail.mil

References:

1. Issenberg SB, McGaghie WC, Petrusa ER, Gordon DL, Scalese RJ. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. Medical Teacher, Vol. 27, No. 1, 2005, pp. 10–28.

2. Ericsson KA. Deliberate practice and the acquisition and maintenance of expert performance in medicine and related domains. Academic Medicine, 79 (10, Suppl), 2004, pp. S70–S81.