Ming Leu

Broad Areas of Research Interests: Manufacturing, Design, and Dynamic Systems

Specific Research Interests: Rapid Prototyping, Additive Manufacturing, CAD/CAM, Robotics, Modeling and Simulation, Design and Manufacturing Automation, Virtual and Augmented Reality.

Areas of Teaching Responsibility: Computer Aided Design, Digital Design and Manufacturing, dynamic Systems, Automatic Control

Description of Scholarly Expertise: My scholarly expertise is broadly in the area of design and manufacturing automation including CAD/CAM, robotics, virtual prototyping, rapid prototyping, and additive manufacturing. My earlier academic research covered machinery vibration and noise, robot kinematics and dynamics, manufacturing process modeling, NC machining simulation and verification, parts mating in compliant assembly, and automated planning for robotic assembly of printed circuit boards. More recently, in virtual prototyping research, I developed multimodal (graphic, haptic and auditory) rendering techniques and their applications to virtual sculpting, virtual bone surgery, and other virtual reality applications, which are all based on geometric and physical modeling. In rapid prototyping research, I developed a novel, environmentally conscious freeform fabrication process called Rapid Freeze Prototyping (RFP), a process which builds three-dimensional parts from CAD models by depositing and freezing water droplets layer by layer automatically via computer control. This research also included investigating use of the built ice patterns (in lieu of wax patterns) for investment casting. In additive manufacturing research, I collaborated with Missouri S&T colleagues and Boeing engineers to develop the Freeze Extrusion Fabrication (FEF) process and use it to build 3D parts with high and ultra-high temperature ceramics by computer-controlled extrusion and deposition of aqueous pastes, followed by binder burnout and sintering of the built parts. Research has also been conducted using this novel additive manufacturing process and the Selective Laser Sintering (SLS) process to develop aerospace, energy and biomedical applications.

Laboratory Location: 105, 111, 209 Toomey

Laboratory Description: The Additive Manufacturing Laboratory includes two types of machines: two (2) freeze extrusion fabrication (FEF) machines and one (1) selective laser sintering (SLS) machine. The SLS machines were built collaboratively with Boeing-St. Louis with research funding from the National Science Foundation, the Air Force Research Laboratory, and the Boeing Company. One of the two FEF machines has a single extruder and has been used to demonstrate fabrication of Al_2O_3, ZrB_2 and 13-93 bioglass parts, followed by freeze drying, de-binding and sintering to produce 3D dense ceramic and bioglass components. The other FEF machine has been built with three extruders to provide the capability of mixing multiple material pastes at any desired ratios and depositing the mixed pastes for freeze extrusion fabrication of functionally graded composites. The SLS machine, which is the DTM 2000 sintering station, has been used to study selective laser sintering of 3D parts from Al_2O_3, ZrB_2, 13-93 bioglass, and graphite powders for aerospace, biomedical, and energy applications.

The Virtual Reality Laboratory was established with funding support from the National Science Foundation and Ford Motor Company. Its equipment currently consists of the following: one CAVE™ (10'x10'x10') four-wall virtual reality system, one WorkWall™ (6'x8') powered wall, two Sensable Technology's PHANToM haptic devices, one CyberTouch glove, several 6-DOF optical and electromagnetic motion trackers, many pairs of CrystalEyes shutter glasses, CAVE Lib and VR Juggler software, etc. for development of VR/AR applications. Additionally, there is a driving simulator consisting of an instrumented Ford truck cabin and three LCD projectors with a 6.5'x25' display screen for virtual driving experiments.