

Visiting Scholars



Wang Yanhong
Associate Professor at the Wuhan University of Science and Technology, China visited ISM/UK for a year. Her major research work at ISM was focused on remanufacturing & 6R applications in sustainable manufacturing.



Ridvan Aydin
He is currently a Postdoctoral Researcher in ISM/UK. Received his Ph.D. in Industrial and Systems Engineering from the Hong Kong Polytechnic University, Hong Kong. His research is on total lifecycle product design optimization.



Jiankang Huang
Associate Professor in the School of Materials Science and Engineering at the Lanzhou University of Technology (LUT), Lanzhou, China is visiting ISM/UK for a year. His research is on numerical analysis of welding processes and dissimilar metal joining.



Ke Zhang
Associate Professor in the School of Material Science and Engineering, Shanghai Jiaotong University in China is visiting ISM/UK for a year to conduct research on weld pool oscillation behaviors based on 3D surface monitoring and analysis.



Marvin Hardt
Master student at the Laboratory for Machine Tools and Production Engineering (WZL) of the RWTH Aachen University, Germany is visiting ISM/UK for six months to conduct research on surface integrity and biocompatibility in cryogenic turning of *Ti-6Al4V*.



Tobias Seelbach
Master student at the Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University, Germany is visiting ISM/UK for six months to conduct research on surface integrity in cryogenic machining of *AISI 304* stainless steel.

About the Institute for Sustainable Manufacturing

Details about our new projects, lab facilities, books, recent publications, patents, and more can be found on our website!

Contact Us

University of Kentucky
414 CRMS Building
147 Graham Avenue
Lexington, KY 40506-0108, USA

Phone: (859) 323-3238
Fax: (859) 257-1071
www.ism.uky.edu

Journals

International Journal of Sustainable Manufacturing
www.inderscience.com/ijsm
Journal of Machining Science and Technology
www.tandfonline.com/toc/lmst20/current

ISM Faculty and Staff



F. Badurdeen Y.T. Cheng L. Holloway I. S. Jawahir W. Li D. Sekulic Y. Zhang J. Seay J. Schoop D. Ferguson

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- Visit www.engr.uky.edu/mfs
- Contact Professor Fazleena Badurdeen, Director of Graduate Studies for Manufacturing Systems Engineering Program at badurdeen@uky.edu
- Contact Graduate Program Coordinator at (859) 218-0611 or manufacturing@uky.edu

Sustainable Manufacturing

Products, Processes, and Systems

Volume 3, Issue 1

Institute for Sustainable Manufacturing Newsletter

Fall 2016

A Message from the Director



We are continuing to make good progress with our overall mission of conducting academic research (basic and applied), offering educational programs, and providing outreach to industry. With focus on products, processes and systems, we have been actively engaged in several research projects sponsored by industry groups and agencies. Once again, we have exceeded our expectations in research productivity with increased funding, research publications, graduate student productivity and industry outreach activities. Here are some highlights of achievements in 2016:

- ISM faculty, Professor Fazleena Badurdeen and Professor Dusan Sekulic received major funding from DoD agencies (DMDII and NASA) totaling over \$2.2M for two projects involving industry partnerships and international collaboration. They both also served as Co-PIs for a major DoE-funded five-year project proposal for Developing Next Generation Energy Assessment Workforce which received a total funding of over \$1.8M.
- Significantly expanded industry interactions and developed new alliances to compete for a national level manufacturing innovation institute. Also, several universities and national

labs joined our partnership. Our institute provided leadership in this major effort. While this effort was not rewarded immediately, the partnerships formed and experience gained, will be useful in future opportunities.

- Successfully completed the NIST-AMTech project with strong support from three industry partners: GE Aviation, Toyota and Lexmark. A national strategic roadmap was developed for sustainable manufacturing, and two dedicated follow-up workshops, one on automotive manufacturing and the other on aerospace manufacturing, were organized and hosted.
- Continued to offer courses for the online Masters Degree Program in Manufacturing Systems Engineering, focusing on sustainable manufacturing, with more online courses added to the list. From 2016 this program is fully online, and our enrollment continues to increase.
- Continued to expand our international collaboration with researchers from Australia, Brazil, China, Finland, France, Germany, Italy, Lebanon, Malaysia, Norway, Portugal, Slovenia, Turkey and the United Kingdom. New researchers from Germany, China and Turkey joined our research groups this year to conduct collaborative research.

I. S. Jawahir, Director, ISM

A DMDII-funded Project Focusing on Predictive Modeling for Innovative Product Design & Analysis for Total Lifecycle Sustainability

This project focuses on developing capabilities for digitally-enabled, total lifecycle-based next generation product design, linking and sharing information related to the total PL from all supply chain partners and end-users to enable multi-criteria decision making and predictive modeling to design and market multi-lifecycle products for improved sustainability performance.

This integrated capability will enable product designers and manufacturers to evaluate design alternatives, investigate trade-off decisions to optimally select materials, processes and system requirements, evaluate various 'ilities' and conduct risk analyses with seamless information sharing between partners.

Project Objectives

- Develop and validate an integrated software platform linked through a 'digital thread.'
- Develop and validate predictive computational modeling tools for total lifecycle product design optimization, simulation and uncertainty & risk analysis.
- Demonstrate the application of the digitally integrated modeling tools to perform total lifecycle-based 'ilities' analyses using an industry testbed

University of Kentucky Project Team

F. Badurdeen (PI)
I.S. Jawahir (Co-PI)
K.E. Rouch (Co-PI)
Wei Li (Co-PI)



Ridvan Aydin (Post-doctoral Researcher)
Adam Brown (Graduate student)

Industry Partners



New Research Grants and Projects

- **PI: F. Badurdeen, Co-PIs: I.S. Jawahir, Keith Rouch, Mike Li;** Predictive Modeling for Digitally-enabled, Multi-criteria Decision Making for Innovative Product Design & Analysis for Total Lifecycle Sustainability, DMDII; \$1,202,396; Aug. 2016 – Aug. 2018.
- **PI: F. Badurdeen; Co-PIs: I.S. Jawahir, Mike Li, Mike Renfro;** Re-inventing Eric – GE Transportation; General Electric Transportation; \$30,000; Jan. 2016 – Sep. 2017.
- **PI: F. Badurdeen;** Workshop: Research and Education Needs in Sustainable Manufacturing; Atlanta, GA; July 2016; National Science Foundation; \$24,900, July – Dec. 2016.
- **PI: D. Colliver; Co-PIs: F. Badurdeen, D. Sekulic, T. Henninger;** KIAC: Developing Next Generation Energy Assessment Workforce; Dep. of Energy; \$1,851,564, Oct. 2016 – Sep. 2021.
- **PI: D. Sekulic** (with Co-PI: Prof. S. Mesarovic from University of Washington; Other PIs: Mikhail Krivilev, Udmurt State University, funded by ROSCOSMOS; Jan Fransaeer, University of Leuven, funded by ESA/BELSPO); BRAZing of Aluminum Alloys IN Space, BRAINS, An International Collaborative Project, funded by NASA (USA), ESA, European Space Agency, Roscosmos, Russian Space Agency, \$1.2M (Total Funding) including NASA (USA) funding of \$597,439.
- **PI: Mike Li;** Systematic evaluation of operating room scheduling across the perioperative process, Agency for Healthcare Research & Quality (AHRQ), \$97,358; Sep. 2016 – Sep. 2018.

Awards and Honors

Keynote Presentations at International Conferences

Y. Zhang delivered three invited keynote presentations:

- “Establishing the Foundation to Extract Human Welder Intelligences”, 10th Int. Conference on Trends in Welding Research & 9th Int. Welding Symposium of Japan Welding Society, Oct. 11-14, 2016, Tokyo, Japan.
- “Human-Robot Collaborative Welding”, 2016 IEEE Int. Workshop on Advanced Robotics and its Social Impacts, July 8-10, 2016, Shanghai, China.
- “Scientific Foundation to Extract Human Intelligence during Complex Operations with Demonstration in Intelligent Welding”, Int. Forum of Welding Technology (IFWT), June 13, 2016, Beijing, China.

F. Badurdeen delivered two invited keynote presentations:

- “Extending 6R-based Closed-loop Sustainable Manufacturing Practices for Sustainable Built Environments”, 7th Int. Conf. on Sustainable Built Environments, Dec. 16-18, 2016, Kandy, Sri Lanka (Keynote presentation)
- “Strategies for Value Creation through Sustainable Manufacturing”, 14th Global Conf. on Sustainable Manufacturing (GCSM), Oct. 3-5, 2016, Stellenbosch, South Africa (Co-authored with Prof. I.S. Jawahir).



Prof. F. Badurdeen presents the GCSM keynote paper

I.S. Jawahir delivered five invited keynote presentations:

- “Correlation of Surface Integrity with Processing Parameters and Advanced Interface Cooling/Lubrication in Burnishing of Ti-6Al-4V Alloy”, 17th Int. Conf. on Advances in Materials and Processing Technologies (AMPT 2016), Kuala Lumpur, Malaysia, Nov. 8-11, 2016.
- “Sustainable Machining: Predictive Models and Optimization Techniques for Improved Product/Process Performance”, 7th Int. Symposium on Machining (UTIS 2016), Istanbul, Turkey, Nov. 3-5, 2016.
- “Cryogenic Manufacturing Processes”, 66th CIRP General Assembly, Guimaraes, Portugal, Aug. 21-27, 2016.
- Cryogenic Machining of Biomaterials for Improved Functional Performance, Life and Sustainability in Biomedical Implants”, 7th CIRP Conf. on High Performance Cutting (HPC), Chemnitz, Germany, May 31 – June 2, 2016.
- Sustainable Products from Sustainable Processes: An Outlook Towards Clean Factories of the Future”, Horizon 2020 EU Project – FOCUS Consortium Workshop on Clean Factories, Brussels, Belgium, Feb. 15-16, 2016.



Prof. I.S. Jawahir presents the UTIS keynote paper

I.S. Jawahir presented in two invited plenary panels:

“Surface Integrity Applications: Products and Processes for Aerospace, Automotive, Biomedical and Power Industries”, 3rd CIRP Conf. on Surface Integrity, Charlotte, NC, USA, June 8-10, 2016.

“Implementing Sustainable Manufacturing: Recent Progress, Challenges and Opportunities”, Opening Plenary Session, Workshop on Sustainable Manufacturing, US Dep. of Energy, Portland, OR, Jan. 6-7, 2016.

I.S. Jawahir serves as:

Honorary Chairman, 3rd Int. Conference on Sustainable Design and Manufacturing (SDM-2016), Chania, Crete, Greece, Apr. 4-6, 2016.

Co-Chairman, 5th Int. Congress on Sustainability Science and Engineering (ICOSSE 2016), Suzhou, China, Oct. 24-27, 2016.

Honorary Chairman, 16th CIRP Conf. on Modeling of Machining Operations (CMMO), ENSAM, Cluny, France, June 2017.

Jeffrey R. Seay:

Outstanding Poster Presentation Award, Willett, S. and J. Seay (2016): “A Green Chemistry Approach for Producing Non-Synthetic Pesticide in Under-Developed Regions”, 4th Int. Symposium on Sustainable Chemical Product and Process Engineering, Nanjing, China.

Rapid Fire Poster Session 1st Place Award, and 1st Place Student Research Poster Award, Joshi, C. and J. Seay (2016): “An Appropriate Technology Solution for Addressing the Problem of Global Municipal Waste Plastic Accumulation”, 5th Int. Congress on Sustainability Science and Engineering, Suzhou, China.

Outstanding Oral Presentation Award, Joshi, C. and J. Seay (2016): “Developing a Sustainable Appropriate Technology Based Solution to Convert Municipal Solid Waste Derived Plastic into Fuel Oil”, 4th Int. Symposium on Sustainable Chemical Product and Process Engineering, Nanjing, China.

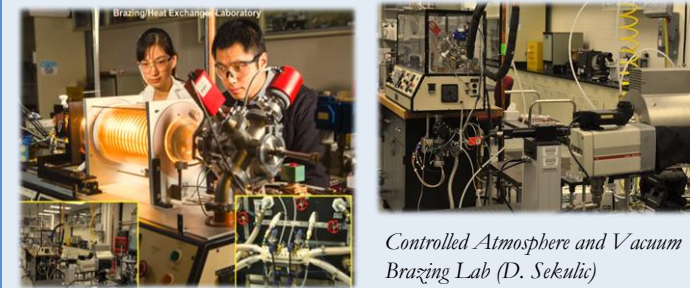


Prof. J. Seay and his graduate student, Chandini Joshi with their award certificates

ISM Research Topics

Dusan Sekulic

- High temperature liquid metal surface tension driven flow modeling (brazing and 3-D printing)
- Kinetics of brazed joint formation in terrestrial and space conditions
- Impact of nano-particles doping on microstructure evolution for refractory metals systems
- Homogenization of ceramics-metal-ceramics interface domains



Controlled Atmosphere and Vacuum Brazing Lab (D. Sekulic)

I.S. Jawahir

- Product design for sustainability
- Modeling and optimization of sustainable manufacturing processes
- Metrics-based sustainability analysis of manufactured products and manufacturing processes
- Closed-loop material flow for multi life-cycle products with circular economy benefits
- Sustainable machining processes (Dry, MQL and cryogenic machining technologies)



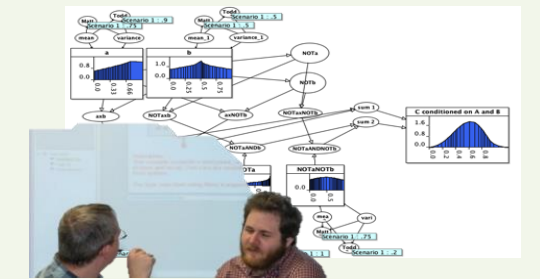
Sustainable Machining Lab (I.S. Jawahir)

Jeffrey Seay

- Converting Waste Plastic to Fuel Oil in Developing Countries
- Converting Biomass to Green Chemical Products in Developing Countries
- Modeling Biomass Conversion Reaction Kinetics

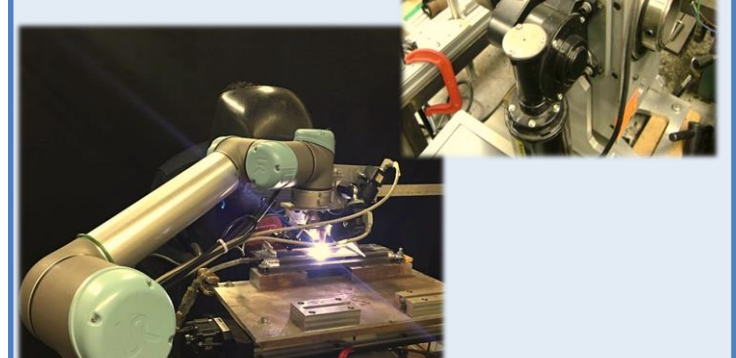
Fazleena Badurdeen

- Total lifecycle product sustainability optimization
- Sustainable manufacturing through Reconfigurable Manufacturing Systems
- Supply chain risk and resilience modeling
- Modeling and analysis of manufacturing systems



YuMing Zhang

- Real-time monitoring and control of innovative welding processes
- Human welder modeling
- Human welder centered control
- Human-robot collaborative systems



Intelligent Welding Robot (Y. Zhang's Lab)

Mike Li

- Adaptive scheduling and control
- Optimization models to address management issues in different time phases
- Framework to evaluate system performance for specific individual objectives, and their trade-offs
- Operating room scheduling and control in healthcare systems
- Coordination for information sharing among suppliers, manufacturers, and retailers