Visiting International Scholars

Guang Chen
An Associate Professor of Mechanical Engineering at Tianjin University, China specializing in modeling of machining process joined the ISM in December 2017 as a Visiting Scholar for a year to conduct research on surface integrity in machining of *Ti-6Al-4V* alloy with different cooling strategies.

Alperen Bal
A Ph.D. candidate in the Industrial Engineering Department of Istanbul Technical University, Turkey joined the ISM in May 2018 for a year to conduct collaborative research on optimization and simulation of IoT-enabled sustainable supply chains.

2019 ISM Short-course Announcement

- Introduction to Sustainable Manufacturing (Professors Julius Schoop, Fazleena Badurdeen and I.S. Jawahir)
- Sustainable Product Development (Professor I.S. Jawahir)
- Sustainable Value Stream Mapping (Professor Fazleena Badurdeen)
- Theory and Practice of Advanced Finish Machining, Grinding and Polishing (Professor Julius Schoop)

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!

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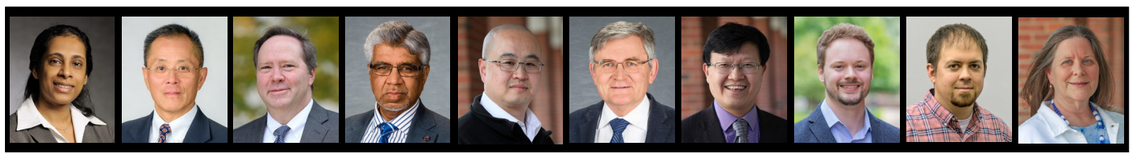
Journals

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. Schoop A. Price D. Harrod

Sustainable Manufacturing

Products, Processes, and Systems

Volume 5, Issue 1 **Institute for Sustainable Manufacturing Newsletter** **Fall 2018**

A Message from the Director

With our focus on products, processes and systems, ISM faculty and researchers have been in the forefront of research and applications in several research projects sponsored by industry groups and agencies. During the last six years, ISM has been making excellent progress with our overall mission of conducting academic research (basic and applied), offering educational programs, and providing industry outreach. Once again, we have increased our research productivity with new funding, research publications, graduate student productivity, and industry outreach. Here are some highlights of achievements in 2018:

- In Fall 2018, Dr. Julius Schoop was hired as an Assistant Professor in Mechanical Engineering and a core ISM Faculty. He brings in a new perspective with his unique expertise in advanced finishing processes and surface engineering.
- Several ISM faculty delivered invited keynote presentations and lectures in different countries. Their research work was also recognized with medals and awards by professional societies – details are shown on page 2.
- ISM and the University of Kentucky, in partnership with the Technical University of Berlin (Berlin, Germany) organized and hosted the 16th Global Conference on Sustainable Manufacturing in October 2018. This conference was attended by over 160 participants from 28 countries. 12 keynote presentations were made by internationally-known speakers showing the state-of-the-art developments in several emerging areas of sustainable manufacturing – details are shown on page 3.
- ISM faculty continued to expand our international collaborations with researchers from Australia, Brazil, China, Finland, France, Germany, Italy, Lebanon, Malaysia, Norway, Portugal, Slovenia, Sweden, Turkey and United Kingdom. New researchers from Germany, Sweden, China and Turkey joined ISM in 2018 to conduct collaborative research.
- We 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. Since this program became fully online in 2016 our enrollment has increased significantly during the last few years.
- ISM faculty continued their industry interactions with major companies such as GE Aviation, Toyota and Lexmark International. ISM also continued its interactions with several US universities and national labs. We look forward to future opportunities for strategic partnerships in large research proposals at the national level.

I. S. Jawahir, Director, ISM

Brazing of Aluminum Alloys in Space

An international research project funded by NASA in USA and the Roscosmos State Corporation for Space Activities in Russia — a rare feat in itself — is ongoing at the University of Kentucky (lead), Washington State University and Udmurt State University. The project, "Brazing Aluminum Alloys in Space", studies how molten metal behaves in space and could enable manufacturing/assembly and/or repairs in space.

Brazing is planned under 0-g at the International Space Station (ISS) as well as at 1-g (terrestrial conditions under controlled atmosphere and vacuum). This may open venues toward applications in space and/or on extraterrestrial objects (like on Mars), as well as other applications. The targeted technological applications involve mitigating the consequences of possible collision with micro-meteorites and space debris.

Project Objectives

- In situ, in real time study of kinetics and equilibrium of Al-Si molten surface states, followed by a phase-field modeling
- Prediction of capillary flow of micro and/or macro spreading of Al-Si alloys over aluminum substrates.
- Development of a theory based on phase field simulations of triple line movements, porosity and microstructure
- Corroboration of experimental findings executed at the ISS and terrestrial benchmark

University of Kentucky Project Team

Dusan P. Sekulic (PI)
Cheng-Nien Yu (Graduate student)
Yangyang Wu (Graduate student)

Partners

Washington State University
Udmurt State University

Funding Agencies

NASA, USA
Roscosmos, Russia

New Faculty Spotlight - Julius Schoop

Julius Schoop joined the Department of Mechanical Engineering (ME) and Institute for Sustainable Manufacturing as Assistant Professor in August 2018. Dr. Schoop is a materials science and manufacturing process expert (B.S., Chemical Physics, Centre College, 2011; Ph.D., University of Kentucky, 2015) with combination of deep applied and theoretical knowledge of advanced manufacturing processes, particularly machining and finishing processes such as grinding and polishing.

Through in-situ, multi-sensor experimental observation using digital image correlation in ultra-high speed (~1 million frames per second) microscopy, the Schoop research group is building industrially-relevant predictive models of the complex behaviors materials experience during finish machining and grinding/ polishing operations. It is envisioned that through improved and readily deployable closed-loop, sensor-based process models, highly scalable manufacturing processes such as machining, polishing and grinding can not only be used to impart dimensional accuracy and surface quality, but also to induce tailored surface properties, such as compressive residual stress profiles and micro/nano-textured surfaces. Moreover, ongoing research on eliminating the need for ineffective and environmentally harmful coolants/lubricants through techniques such as cryogenic hybrid cooling, an emerging technology developed at ISM, has shown great promise to improve process sustainability.

In addition to process modeling, Dr. Schoop is also currently developing novel manufacturing processes with great application potential in the aerospace, automotive and biomedical industries. These new processes are capable of up to 50 times higher metal removal rates in hard materials than milling and grinding, while also offering improved surface quality and tool-life.

Further, the Schoop research group is developing and refining a patent-pending testbed for in-situ characterization of machining and finishing processes, located in the Advanced Finishing and Surface Engineering Laboratory at the Institute for Sustainable Manufacturing (RMB R012; see Figure).

Awards and Honors

Keynote Presentations at International Conferences

Fazleena Badurdeen delivered a keynote presentation titled "Manufacturing in the Sharing Economy: Opportunities and Challenges" and also conducted a workshop at the Production and Operations Management Society (POMS) International Conference held in Kandy, Sri Lanka in December 2018.

YuMing Zhang delivered a keynote lecture titled "Machine Learning Based Detection of Weld Joint Penetration from Weld Pool Reflection Images" at the 2018 International Conference on Robotic Welding, Intelligence and Automation held in Guangzhou, China in December 2018.

Dusan Sekulic delivered an invited lecture titled "The Role of Wetting in Joining" at the 14th International Ceramic Congress held in Perugia, Italy in June 2018.

I.S. Jawahir delivered a keynote presentation titled "Predictive Models for Process-induced Surface Integrity to Achieve Desirable Functional Performance in Manufactured Components" at the opening plenary session of the 2018 CIRP Conference on Surface Integrity held in Tianjin, China in July 2018.

I.S. Jawahir delivered a keynote presentation titled "Engineered Surface Integrity Induced by Sustainable Machining for Improved Product/Process Performance" at the plenary session of the 2018 High Speed Machining Conference held in Guangzhou, China in November 2018.

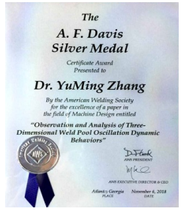
Recognition of ISM Faculty

Fazleena Badurdeen received College of Engineering Dean's Award for Excellence in Service 2018.

Fazleena Badurdeen was appointed as Associate Editor for the Resources, Conservation and Recycling journal.

YuMing Zhang was recognized by Society of Manufacturing Engineers as the 2018 Outstanding Associate Editor for Journal of Manufacturing Processes.

YuMing Zhang received the 2018 ***A. F. Davis Silver Medal*** from the American Welding Society.



Fazleena Badurdeen was appointed to the Fulbright Specialist Roster for 2018-2021.

Dusan Sekulic received the **Robert L. Peaslee Brazing Award** from the American Welding Society along with Dr. Hai Fu.

Dusan Sekulic received the Honorable Mention Award from the American Society for Gravitational and Space Research 2018 Art Competition.

ISM Successfully Organized and Hosted the 16th Global Conference on Sustainable Manufacturing (GCSM) in October 2018

The 16th Global Conference on Sustainable Manufacturing (GCSM) was held successfully from October 2 – 4, 2018 in Lexington, KY. The conference was jointly organized and hosted by the Institute for Sustainable Manufacturing (ISM) at the University of Kentucky, Technical University of Berlin IWF, and Fraunhofer IPK. The theme of GCSM 2018 was 'Sustainable Manufacturing for Global Circular Economy'.

This conference brought together more than 160 attendees from 28 countries providing a truly global forum of academics, researchers, and specialists from international universities, research institutes and industry working on topics related to sustainable manufacturing. The President of the University of Kentucky, Dr. Eli Capilouto ceremonially opened the conference warmly welcoming all attendees. Prof. I.S. Jawahir the Chair of GCSM 2018 and Director, Institute for Sustainable Manufacturing with his opening remarks provided an overview of the history of the GCSM conference series. The opening session was moderated by Prof. Fazleena Badurdeen, Co-chair for GCSM 2018.

The conference featured twelve keynote speakers and two luncheon speakers who shared recent advances in cutting-edge research and industry practices; these prominent and internationally-recognized experts elaborated how sustainable manufacturing technologies can enable the Circular Economy. Thirty-six technical sessions were held over the three days with themes focusing on products, processes and systems, and crosscutting themes such as innovation, education and training.

A unique feature of the GCSM conference series is its integration of industrial engineering principles and perspectives, sustainable manufacturing applications in emerging and developing countries, and emphasis on education and workforce development for sustainable manufacturing. A unique session on Day 1 of the conference was a panel discussion with Manufacturing USA Institute directors.

The panel was moderated by Prof. Gunther Seliger (Technical University of Berlin, Germany) and Dr. Dean Bartles (President, National Tooling and Machining Association). Another unique feature of GCSM 2018 was a special industry session, organized for the first time in the conference history, to enhance better collaboration between academics engaged in sustainable manufacturing research and industry practitioners. The industry session started with a keynote presentation and an industry panel discussing opportunities and challenges implementing sustainable manufacturing in industry. This session also included case studies and success stories by select companies who are industry leaders in sustainable manufacturing.

The conference banquet, sponsored by Lexmark International Inc., was held on October 3, 2018 at the Kentucky Horse Park. The conference attendees had the opportunity to tour the International Museum of the Horse and meet and greet a few horses in the park. In addition to the main events, GCSM 2018 also included several pre-conference and post-conference activities. A pre-conference workshop on "Introduction to Sustainable Manufacturing: Recent Trends, Metrics and Methodologies for Evaluation" was organized by the Institute for Sustainable Manufacturing on October 1, 2018 and held at the University of Kentucky Student Center. Several conference attendees also toured the Sustainable Machining Research Laboratory, Electron Microscopy Center (EMC), and the Center for Nanoscale Science and Engineering (CeNSE) at the University of Kentucky. Attendees also had the opportunity to participate in several industrial plant tours held after the conference. They included the Toyota Motor Manufacturing Kentucky (TMMK) plant in Georgetown, Infiltrator Water Technologies in Winchester and Novelis Inc. in Berea.