DEPARTMENT OF MECHANICAL ENGINEERING
WILLIAM MAXWELL REED SEMINAR SERIES

"Spray Painting and Curvilinear Coordinates."

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Presentation Abstract

This presentation was the product of research in the UK Institute for Technology Development (IR4TD), founded by Dr. Kozo Saito. Spray painting, or the atomization of a fluid, is a complex process with macro and micro-scale analyses. At the macro scale, weight deposition per unit area, transfer efficiency, emissions, and costs are typical parameters of interest. On the other hand, at the micro-scale, drop size, ligament spacing, stability of fluid/air interfaces, and film thickness profiles on a rotary atomizer are standard parameters. Since it has excellent drop formation properties, rotary atomizers are the choice process in automotive assembly plants. Rotary atomizers are high-speed spinning axisymmetric surfaces that transfer kinetic energy to a fluid film through the no-slip boundary condition. Virtually all analytical modeling of film properties on a rotary atomizer exists in cylindrical or spherical coordinate systems where a coordinate, such as constant polar angle or constant radius, defines the surface profile of the rotary atomizer. Being confined to a coordinate axis raised the question and curiosity if it is possible for an atomizer profile to be functionally defined. As it turns out, the functionally defined atomizer surface is a perfect application of surface following coordinates. However, in this "user-defined coordinate system," finding vector operators such as those used in the Navier-Stokes equations is no longer a case of simply looking online or in a standard reference. Most likely, these operators are with a bit of differential geometry.

Speaker Bio

Dr. Mark Doerre is currently a Lecturer at the University of Kentucky in the Mechanical Engineering Department. Before teaching, he worked in the private sector for almost 40 years as an Engineer and an Engineering Manager. Additionally, he was a 7/24 Operations Manager of domestic production and a Manager of Project Managers. He is an inventor on 11 patents and published four articles. At Lexmark International, Mark was a Senior Technical Staff Member, a position held by a few percent of their engineering community. Mark was an Engineering Manager of teams based in the US, Mexico, Scotland, The Philippines and traveled extensively to procure semi-conductor equipment and factory automation. In the area of MEMS (Micro Electro Mechanical Systems), he worked on the electronic circuit and fluidic chip designs on 8" wafers, nanometer resolution high precision laser interferometer air bearing positioning systems constructed from Inconel and ceramics. His teams designed lean workflow cells containing contact and stepper photolithography, TEL Coat and Develop cluster tools, Surface Technology Systems (STS) Deep Reactive Ion Etch C4F8/SF6 Via Formation Tools. He established high-volume Krypton Fluoride Excimer laser micromachining tools for fabricating micron-level fluidic passages. Over the years, his areas procured hundreds of millions of dollars worth of MEMS fabrication and assembly equipment. Before employment at IBM/Lexmark, he worked at the General Electric Turbine Business Group, and his first internship was at General Dynamics Electric Boat Division. Mark holds a BSME from Worcester Polytechnic Institute, an MSME from Massachusetts Institute of Technology, and a Ph.D. from the University of Kentucky. Community Service has included working 18 Habitat for Humanity Homes and was the Designer, Framing, Windows, Siding crew leader on six homes.

Date: Friday, November 12, 2021
Time: 3:00 PM EST
Place: Whitehall Classroom Building 114
Contact: Dr. Alexandre Martin 257-4462

Attendance open to all interested persons

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