Professional Biography: EMI Board of Governors Candidate

Michael Hillman is a Principal Scientist at Karagozian & Case Inc. (K&C), where he leads the development of advanced meshfree methods for problems intractable to traditional finite element techniques. His research spans computational solid dynamics, fluid-structure interaction, and coupled thermo-mechanical systems, with direct applications to blast, fragment-impact, geomechanics, 3D printing, and extreme deformations.

He is the technical lead on K&C's meshfree code FEMFRE, and spearheaded its initial v1.0 release. The code is used extensively in-house and by external collaborators such as the U.S. Army ERDC and the LIFT manufacturing innovation partnership. More recently, he has been developing constitutive models for complex materials such as wood and ceramic matrix composites, focusing on rate- and confinement-dependent orthotropic damage-plasticity. He remains active in research and continues to publish peer-reviewed work while in industry.

Before joining K&C, Dr. Hillman was a tenured Associate Professor of Civil Engineering at Penn State, where he held the L. Robert and Mary L. Kimball endowed professorship. His academic research was funded by the National Science Foundation (including an NSF CAREER award), the U.S. Army, and private industry. He graduated multiple Ph.D. students, managed a \$1.8M research program, and led the development of the MEGA code for parallel meshfree simulations. He is also co-author of the book *Meshfree and Particle Methods: Fundamentals and Applications* (Wiley, 2023), alongside pioneers Ted Belytschko and J.S. Chen.

Dr. Hillman's technical contributions include the formulation of *variationally consistent integration* (VCI), a framework ensuring arbitrary-order accuracy and convergence in Galerkin methods, and *naturally stabilized nodal integration* (NSNI), a parameter-free approach enabling large-scale simulations with high stability and efficiency. He also developed a unified framework, RKPD, connecting RKPM and state-based correspondence peridynamics—introducing a generalized concept of nonlocal derivatives and enabling arbitrary-order accurate peridynamic methods for fracture and damage, which had not previously been available. These contributions have also served as a foundation for ongoing work by other research groups, with numerous publications building upon the VCI, NSNI, and RKPD frameworks. His methods have been implemented in software used by the Department of Defense (e.g., NMAP, FEMFRE, MECA), the Department of Energy (SIERRA), the commercial code LS-DYNA, and private industry (e.g., MEGA).

Dr. Hillman received his Ph.D. in Civil Engineering from UCLA in 2013 and was a postdoctoral scholar in the Department of Structural Engineering at UC San Diego, and the Center for Extreme Events Research (CEER). He is the past Chair of the EMI Computational Mechanics Committee and serves on technical committees in the U.S. Association for Computational Mechanics (USACM). In service roles he continues to advocate for bridging the gap between academic research and industry practice.

EMI Board of Governors: Vision and Commitment

I am honored to be considered for the Board of Governors of the Engineering Mechanics Institute (EMI). My experience in both academia and industry has given me a clear view of the strengths within each, and the disconnects between them. I believe this makes me well-suited to contribute meaningfully to EMI's mission. The Institute is uniquely positioned to benefit society by building strong bridges between the two spheres—but only if it stays focused on advancing engineering mechanics.

In recent years, we've seen mission drift in universities and professional organizations—consuming bandwidth and diverting focus from the service of technical disciplines. Such efforts pull us further from the reason these institutions were founded. EMI's credibility also depends on maintaining its focus: on engineering, mathematics, and mechanics—not on broader societal issues. I've raised concerns in EMI leadership meetings when these discussions began to overshadow core priorities, articulating what many are reluctant to say. If elected, I will continue to advocate for keeping EMI focused on its technical mission.

That said, the most important area for growth, in my view, is closing the gaps between academia and industry. As a former professor, I understand the appeal of working on rich, intellectual ideas. And in industry, I also see a gap between the development and application of this exciting research. Meanwhile, industry involvement in EMI remains strikingly low, and I see a clear opportunity for the Institute to help close this loop.

Over the past few years, I've worked to address this both within EMI and through the U.S. Association for Computational Mechanics. While serving as Chair of the EMI Computational Mechanics Committee, I spearheaded the organization of a panel that brought together academic researchers and practicing engineers: the Industry Challenges in Engineering Mechanics (ICiEM) panel at EMI 2024. The initiative continues with a minisymposium at EMI 2025. I now also serve on a USACM committee focused on industry-academia collaboration and am actively working with colleagues to adapt this idea for future USACM conferences.

The ICiEM model is one I would like to expand across EMI. This could include dedicated "challenge problems" sourced from industry partners, joint standards co-authored by researchers and practitioners, and stronger incentives for collaborative sessions at EMI conferences. We can also develop new pathways for engineers in industry to engage with EMI year-round.

If elected, I will bring a voice committed to technical excellence, intellectual honesty, and relevance. My efforts to strengthen ties between academia and industry will support EMI in continuing to fulfill its mission—serving the engineering community by staying focused on the development and application of engineering mechanics for the challenges that matter most.

Michael Hillman, PhD

Principal Scientist, Karagozian & Case, Inc. Former Associate and Kimball Professor, Penn State