



Organize a
National Workshop
on
**ICME Approaches to Innovation in
Biomedical Implants**

August 11th – 12th, 2018

&

Pre-Workshop Tutorial

August 10, 2018



Venue: Auditorium, Materials Research Center, Indian Institute of Science, Bangalore.

In the conventional approaches to develop new biomedical implants, the researchers use trial-and-error or one-time-variable method to optimise the process variables. Newer computational approaches are currently being investigated to establish Process–Structure–Properties (PSP) linkages of engineering materials and these concepts are embodied in the Integrated Computational Materials Engineering (ICME) approach. Such an approach is being relatively well explored in the case of metallic materials, e.g. dual phase steels or steels with non-metallic inclusions. Despite several decades of research on biomaterials development, the use of ICME approaches for faster development of biomedical implants as well as to demonstrate how one can develop complex shaped implants with variable sizes of relevance for biomedical applications from the optimised process conditions is rather limited. The reliable and faster development of implantable biomaterials demands a significant extension of *materials knowledge* that allows a rigorous treatment of *biocompatibility* as an important performance characteristic. This extension needs a physics-based understanding of the biocompatibility. In particular, there are major gaps in our fundamental understanding of how the microstructure and composition of a material influence cell functionality, bone remodelling, genotoxicity, and osseointegration. Indeed, a physics-based understanding, capturing, and exploiting of the principles of biocompatibility in a consistent PSP framework would in turn allow a rational design of bioimplants, whose material structure and chemistry are specifically optimized for a given application.

During the proposed workshop to be held during **August 11-12**, a number of leading researchers will deliberate on the opportunities of extending ICME approaches to design and manufacturing of the biomedical implants. The lead speaker of this workshop is Prof. Surya Kalidindi, who is currently a Vajra faculty at the Materials Research Center, Indian Institute of Science, Bangalore. Prof. Kalidindi's research group has recently established some of the main scientific underpinnings needed to pursue the highly ambitious research goals identified above. In recent years, they have developed and demonstrated a foundational framework for a versatile, extensible, and consistent treatment of a broad variety of material structures at different structure/length scales, and their objective low dimensional representation. Combining both the frameworks described above with the emerging toolsets in data sciences (e.g., machine learning, Bayesian inference), Kalidindi's research group has established a novel framework for efficient and systematic mining of the high value PSP linkages needed to objectively drive the materials innovation efforts. This new approach holds tremendous promise for arriving at new and improved materials at dramatically reduced cost and effort.

In the pre-workshop tutorial on **August 10**, Prof. Kalidindi will deliver a series of lectures to develop and demonstrate a novel foundational framework that exploits synergistically the ICME approaches in order to accelerate dramatically the rate at which new and improved biomaterials are designed, developed, and deployed in biomedical applications.

Topics for Pre-workshop Tutorial by Prof. Surya R. Kalidindi (Vajra faculty, IISc, Bangalore)

- A. Processing-Structure-Properties (PSP) Linkages
 - a. Process-structure
 - b. Structure-property
- B. Statistical quantification of structure
- C. Machine learning approaches to PSP linkages
- D. Fusion framework for connecting experiments and models
- E. Integrated Computational Materials Engineering (ICME) vs. Materials Genome Initiative (MGI)

Workshop Themes:

- A. Clinical applications of biomedical implants
- B. Manufacturing of implants
- C. Multiscale simulations for integrated materials, product design and development
- D. Data science and informatics approaches
- E. Breakout sessions to identify and discuss specific collaborative projects

Sponsors**ICME National Hub@IIT Kanpur (<http://www.iitk.ac.in/ICME>)**

Integrated Computational Materials Engineering (ICME) is an emerging and transformative discipline with huge potential. Tata Consultancy Services (TCS), which has expertise in both materials and software development, has been in the forefront of ICME research since its inception. ICME involves multiple disciplines in science and engineering and requires a focused approach in education and research. Keeping this in view, IIT Kanpur and Tata Consultancy Services agreed to establish a National Hub on ICME at IIT Kanpur during the MoU signing ceremony in November 2015. The vision and the objectives of the National Hub are the creation of a multidisciplinary educational & research ecosystem for ICME in the country (a) to carry out cutting edge research on ICME based materials and technology development (b) to train world class manpower in the area of ICME (c) to develop open-source based tools/technologies for ICME and (e) to conduct Annual National Workshop involving all stakeholders.

DBT Center of Excellence on Biomaterials

The Translational Center on Biomaterials for Orthopaedic and Dental applications is sponsored by the Department of Biotechnology (DBT), Government of India. The Center of Excellence (CoE) has been constantly pursuing translational activities at the intersections of engineering, science and medicine. The activities include the design and development of patient-specific biomedical device prototypes for total hip joint replacement (THR) surgery and for dental reconstruction/restoration. The CoE brings together researchers from multiple institutions, academicians, entrepreneurs and young researchers.

Conveners

Prof. Bikramjit Basu, Indian Institute of Science, Bangalore

Prof. Amarendra K. Singh, Indian Institute of Technology, Kanpur

Lead speaker

Prof. Surya R. Kalidindi, Vajra faculty, Indian Institute of Science, Bangalore and Professor, School of Mechanical Engineering, Georgia Tech, USA

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