

Workshop Report

Title: Hands-On Workshop on Advanced Multiscale 3D Modelling and Simulation for Engineering and Biomedical Research

Dates: July 22–26, 2025

Organised by: Department of Mechanical Engineering, NIT Jalandhar

Platform: Online Mode

Supported by: Synopsys Simpleware and Industry Partners

Day 1: Introduction to 3D Modelling and Multiscale Simulation

Inaugural Session from 10 AM onwards

Morning Session – Lecture (11:00 AM – 12:30 PM)

The first day began with an insightful introduction to **Multiscale 3D modelling and simulation using Synopsys Simpleware**. The lecture focused on the fundamentals of simulation at macro, micro, and nano scales. Participants were introduced to 3D imaging data sources such as CT and MRI scans, as well as the data processing pipeline. Real-life applications across biomedical and engineering fields were discussed, showcasing the growing importance of multiscale modelling in research and development.

Evening Session – Practical (3:00 PM – 5:00 PM)

The hands-on session introduced participants to the Simpleware interface and guided them through **setting up the software environment**, importing medical imaging data, and performing initial segmentation. This practical session laid a strong foundation for participants to build simulation-ready 3D models.

Day 2: Biomechanical Modelling and Analysis

Morning Session – Lecture (10:00 AM – 11:00 AM)

The second day focused on biomechanical modelling in orthopaedics and prosthetics. The session covered methods for modelling bone structures and joints, with specific emphasis on real-world applications such as implant design and surgical simulations. Key use cases from orthopaedic biomechanics and prosthetics design helped contextualise the theoretical content.

Evening Session – Practical (4:00 PM – 6:00 PM)

Participants practised segmentation of anatomical features, such as the knee or hip joint, from medical imaging datasets. They then generated simulation-ready models suitable for finite element analysis (FEA) or 3D printing, which are commonly used in orthopaedic research and clinical planning.

Day 3: Material and Structural Analysis

Morning Session – Lecture (10:00 AM – 11:00 AM)

The focus on Day 3 was on mechanical behaviour analysis of materials using imaging-based models. The lecture covered how to model and analyse porous materials and composite structures, highlighting their importance in biomedical implants and structural applications. Stress-strain evaluation, fatigue analysis, and simulation of material performance under various loading conditions were also discussed.

Evening Session – Practical (1:00 PM – 2:30 PM)

In the hands-on session, participants prepared FEA-compatible meshes from imaging data and conducted basic mechanical simulations to assess material behaviour. This session provided direct experience in translating real-world material data into computational models for structural analysis.

Day 4: Soft Tissue and Cardiovascular Modelling

Morning Session – Lecture (10:00 AM – 11:00 AM)

Day 4 focused on soft tissue modelling and cardiovascular system simulations. Participants learned advanced segmentation techniques applicable to organs like the heart, arteries, and veins. Use cases included stent design, vascular compliance studies, and patient-specific cardiovascular modelling.

Evening Session – Practical (4:00 PM – 6:00 PM)

The practical involved heart and vascular segmentation from medical datasets, along with integration of stents or other implants into the segmented geometry. These models were prepared for simulation studies related to fluid-structure interaction and device performance.

Day 5: Advanced Techniques and Workflow Automation

Morning Session – Lecture (10:00 AM – 11:00 AM)

The final day explored workflow automation and integration using Python scripting within Simpleware. Topics included automating segmentation, batch meshing, and exporting models for use in CAD or external FEA software. Emphasis was placed on improving efficiency in large-scale or repetitive tasks.

Evening Session – Practical (3:00 PM – 5:00 PM) Followed by Valedictory Session at 5:30

Participants wrote and executed custom Python scripts to automate parts of the modelling workflow. Integration of segmented models with external simulation software (e.g., ANSYS or Abaqus) was also demonstrated, showcasing a complete pipeline from image data to analysis.

Key Outcomes and Deliverables

- Comprehensive understanding of multiscale 3D modelling principles using real medical and engineering data.
- Hands-on experience in segmentation, meshing, and simulation preparation.
- Exposure to biomechanical and cardiovascular applications, including prosthetic and implant design.
- Practical training in workflow automation and integration using scripting tools.
- Ability to translate medical imaging data into simulation-ready models for real-world research problems.



Dr B R Ambedkar National Institute of Technology, Jalandhar

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Jul 24 · 🌐

The Department of Mechanical Engineering and the Sports and Healthcare Research Centre at Dr. B. R. Ambedkar National Institute of Technology (NIT) Jalandhar, in collaboration with Integrated Microsystems, inaugurated a five-day online workshop titled “Advanced Multiscale 3D Modelling and Simulation for Engineering and Biomedical Research.”

The workshop is being organized with the encouragement and support of Prof. Binod Kumar Kanaujia, Director of NIT Jalandhar, whose visionary leadership continues to foster interdisciplinary research, technological innovation, and strong industry-academia collaboration. His constant emphasis on translational research has opened new avenues for meaningful engagement between academia and industrial partners like Integrated Microsystems.

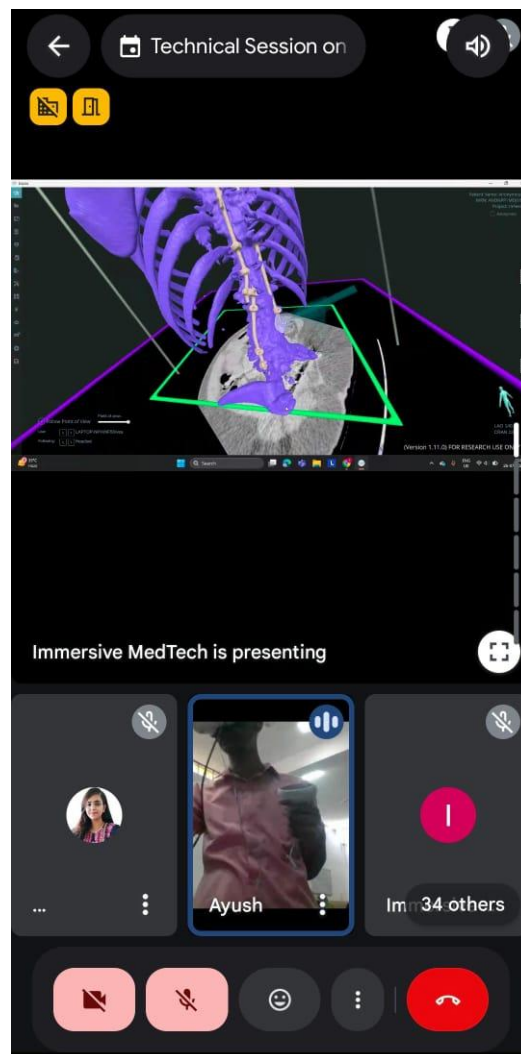
The inaugural ceremony was graced by eminent dignitaries. Prof. T. Srinivas, Head of the Department of Mechanical Engineering, delivered the welcome address and highlighted the department’s research vision. Prof. Arunangshu Mukhopadhyay, Head of the Sports and Healthcare Research Centre, spoke about the critical role of simulation in sports science and rehabilitation. Prof. Rohit Mehra, Dean (Research & Consultancy), emphasized the importance of such workshops in nurturing future-ready researchers and

strengthening NIT Jalandhar’s research ecosystem. A special address was delivered by Mr. Parveen Sikka, CEO of Integrated Microsystems, who introduced participants to the capabilities of real-time image-based 3D modelling and its disruptive applications in both engineering and healthcare domains. He encouraged young minds to explore simulation-based problem solving to bridge clinical and technical gaps.

The workshop witnessed overwhelming interest across the country. The technical sessions will cover a wide range of topics including multiscale modelling (macro to nano scale), biomedical simulations, cardiovascular modelling, automation of research workflows, and advanced image processing tools.

This workshop is being coordinated by Dr. Parnika Shrivastava, Dr. Nitesh Kashyap, and Dr. Mahesh Sah from NIT Jalandhar. The organizing team is committed to delivering a rich and practical experience to all participants, aiming to strengthen computational capabilities for multidisciplinary research challenges.

The workshop will run till July 26, 2025, offering an engaging mix of lectures, live demonstrations, and interactive sessions for researchers, faculty, students, and professionals from across the country.



Immersive MedTech Solution (Presenting)

1:45 PM | jwa-ehmh-qye

2D Views

3:06 PM | jwa-ehmh-qye

Ayush Singh (Presenting)

Case Study 4

Head Model for Realistic Simulation

- In vivo MRI scan of 26 year old male
- Segmentation
 - Threshold, floodfill and filters
 - Segmentation of 12 structures
- In vivo MRI scan of 26 year old male
 - Threshold, floodfill and filters
 - Segmentation of 12 structures

11:26 AM | jwa-ehmh-qye

