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A report “*Modelling extreme deformation and dynamic behaviour of materials using mesh-less methods*” was presented by **Dr. Raj Das** from **Sir Lawrence Wackett Aerospace Research Centre at School of Engineering, RMIT University, Australia.**

Presentation

Dr. Das presented an overview of computational mechanics research at the Centre for Multifunctional and Composite Materials of RMIT University, Australia. Their research covers both fundamental and applied aspects of material behaviour and failure processes. The presentation encompass computational modelling of material deformation, damage and fracture using multi-scale techniques in conjunction with mesh-less methods, novel composite materials development and damage tolerance structural optimisation.

There were highlighted a multi-scale modelling of damage and fracture progression that links nano to macro scales and an associated development of coupled computational modelling tools. The strengths of mesh-less methods was illustrated with reference to both low to high-speed impact induced fractures and small to large scale problems. These include several dynamic fracture and fragmentation processes, such as hypervelocity impact fracture, nano-scale machining and large scale geo-mechanical failures.

He talked about development of novel impact and blast resistant, light weight composite materials, intended for aerospace components, which sometimes are subjected to high-speed loading and extreme deformations. Such loads can occur in the cases of debris impact on spacecraft, bird strike on aircraft engines, blast induced failures, etc. He highlighted some novel shape and topology optimisation methodologies for damage tolerance optimisation, i.e. maximising the residual strength and fatigue life of aero-structures. Case studies were shown for their projects with *Royal Australian Air Force* and *Defence Science and Technology Organisation* that demonstrate the practical implementation of the developed design and analysis methodologies.

Dr. Das finished his speech with an invitation for collaboration to scientists who have interests in the presented topics.

Discussion

Prof. D. Karagiosova: You use SPH method. Did you compare your predictions with some other method, like LS-DYNA? The result ... was it say?

Dr. Das: Yes, we compared with LS-DYNA particularly, some problems were closed. We get very similar results as SPH, but for some problems, LS-DYNA will lead to implement the physics and there are a couple of cases where there is properties changing... We can make more physically based models, improved models, using the meshless method.

Prof. D. Karagiosova asked the lecturer for further-private discussion of the subject and Dr. Das agreed.

Assoc. Prof. P. Djondjorov: What do you mean by analytical approach? Do you mean – you solve some kind of differential equations applying analytical solutions or you use analytical expressions for material parameters?

Dr. Das answered that it is an analytical approach for fibrils, which has first – protein and then - carbohydrate destruction. The fibrils have a helical shape. They found this helix angle and calculated the stiffness combined. And this composite cylinder model takes into account the helical orientation of the fibers, where each fibril is oriented differently.

Prof. V. Kavardjikov. What experimental equipment do you use in your investigations for registration of deformations?

Answer. We have a tensile test, three-point bending, four-point bending setup, we have composite manufacturing facility, composite test facility, we have drop tower for low speed impact, a high speed gas gun...

Prof. V. Kavardjikow: For registration of images?

Answer: We have a 3D CT scanner, X-ray scanner and CT tomography.

Assoc. Prof. V. Vasilev: What constitutive equations do you use? A well known equations for viscoelastic – plastic material or you make your own constitutive equations?

Answer: We use different models...

Assoc. Prof. V. Vasilev: You said that you use a Lagrangian approach...

Answer: Yes, exactly.

The seminar ended with a common picture of the participants.

Secretary of the Joint Seminar in IMech-BAS,
Assoc. Prof. Roumen Krastev