Czech Society for Mechanics
and Institute of Thermomechanics, CAS

invite you to a lecture and discussion within
the lecture series **Institute of Thermomechanics Seminar**

Catch the yield surface, experimentally, theoretically, and computationally

given by

Dr. Li-Wei Liu

Department of Civil Engineering, National Taiwan University, Taipei 10617, Taiwan
Institute of Thermomechanics of CAS, v. v. i., Prague

The yield surface of a material is the boundary of the elastic region where every stress point inside the region result from the elastic response of the material. The experimental evidence shows that the yield surface changes position, size, shape, and orientation during the material undergoing the plastic loading which results in the permanent deformation. Based on the experimental observation, the modelling of the yield surface evolution is a key point to completely simulate the plastic behavior of the material. Most experiments of yield surface detection were conducted in the two-dimensional space (axial-torsional or bi-axial). Due to the complete stress space is six dimensional, detecting the yield surface in the space whose dimension is more than two can collect more detail of the yield surface evolution. For the experiment of yield surface detection, the determination of yield point underpins the accuracy of the geometry of the yield surface. Nowadays, test machines used for the experiments of yield surface detection are usually servo-controlled hydraulic system, hence the scatter of data should be taking into account in the determination of yield point. To this end, an automated yield stress determination based on the Weibull distribution is introduced. After conducting the experiment in the axial-torsional-hoop stress space, yield points are obtained according to the yield-stress determination and designed probing paths. To further capture the global information from these yield points and observe the evolution of yield surface during different pre-loading paths, a convex-closed-cubic polynomial, which is capable of description of the yield surface evolution, including translation, expansion/ contraction, rotation, affine deformation, and distortion in the three dimensional space, is proposed and the corresponding three-stage estimation for parameters of the polynomial is developed. This polynomial enable us to observe the yield surface evolution from the three dimensional point of view and it can also be a candidate of potential yield functions. Furthermore, the computation of elastoplastic models needs more attention to the special mathematical structure of the model containing ordinary differential equations, algebraic equations, and inequalities. Exploring the underlying structure of elastoplastic models shows part of them possesses internal symmetry that is the pseudo-sphere of real pseudo-Euclidean space $R^{p,q}$ on which the proper orthochronous pseudo-orthogonal group $SO_o(p,q)$, a sub group of the Lie group, leaves acts. Based on the internal symmetry, a return-free integration is developed and it keeps the computed stress point on the yield surface automatically and exactly without any extra enforcement during the plastic deformation.

The lecture will be held on Wedneday, March 7, 2018 at 10:00 in the building of the Institute of Thermodynamics (lecture room B), Dolejškova 5, 182 00 Prague 8

Contact persons: Radek Kolman