The Graduate School MUSiC with the Sofja Kovalevskaja – Research Group is inviting for a short course (2 days) on:

“Geometrically-Compatible Dislocation Pattern and Simulations of Plastic Deformations in Crystalline and Amorphous Materials”

December 14 (Fr), 2018  (10.30-11:30 + 14.00-16.00)
December 17 (Mo), 2018  (9.30-11.30 + 14.00-16.00)

Graduiertenschule MUSiC, Appelstr. 11A
Seminar room A 501, 5th floor

Prof. Shaofan Li
Department of Civil and Environmental Engineering
The University of California–Berkeley

In this talk, we present two recent major developments on atomistic-informed multiscale simulations of plastic deformation in crystalline and amorphous solids.

In the first part of the talk, we shall discuss a recently developed multiscale dislocation pattern dynamics called Multiscale Crystal Defect Dynamics (MCDD), in which we put forth a novel concept of Geometrically-consistent dislocation pattern. Based on this notion and higher order Cauchy-Born rule, we have developed a systematic approach that uses the generic geometrically-compatible dislocation pattern in crystals to establish a multiscale crystal plasticity formulation, or an atomistic-informed crystal plasticity.

The main novelties of MCDD-based crystal plasticity are: (1) We have discovered a multiscale quasi-crystal patterns to represent geometrically-necessary dislocation pattern distribution, which is related to the original crystal structure, and (2) We adopt a fourth-order (four scales) Cauchy-Born rule-based strain gradient theory to model constitutive behaviors of various dislocation patterns and crystal defects, and we can simulate single crystal plasticity at sub-micro level or even higher levels. MCDD theory is an atomistic-informed macroscale or multiscale modeling theory that does not require any empirical formalism in the material theory.

In the second part of this talk we shall introduce a recent development of the Multiscale Shear-Transformation-Zone (STZ) theory that can simulate plastic deformation in amorphous solids. In the multiscale STZ theory, we developed a concept of the representative sampling cell (RS-cell) to extend the notion of the unit cell in crystalline materials to amorphous solids. Moreover, we have developed a coarse-grained Parrinello-Rahman molecular mechanics-based Cauchy-Born rule, and by combining it with the RS-cells, we have successfully simulated plastic deformations in a Lennard-Jones binary solid, a benchmark amorphous solid, at macroscale including the yield stress, flow stress, the Bauschinger effect, and plasticity under cyclic loadings, etc. at macroscopic level without any empirical material parameters.
Program

December 14 (Friday):
10.30 – 11.30
14.00 – 16.00
Multiscale quasi-crystal pattern model

December 17 (Monday):
09.30 – 11.30
14.00 – 16.30
Constitutive behavior of single crystal plasticity using MCDD

Registration needed
Easily register until December 10 via Email to schulte@ikm.uni-hannover.de

Speaker’s Bio

Dr. Shaofan Li is currently a full professor of applied and computational mechanics at the University of California-Berkeley. Dr. Li graduated from the Department of Mechanical Engineering at the East China University of Science and Technology (Shanghai, China) with a Bachelor Degree of Science in 1982; he also holds Master Degrees of Science from both the Huazhong University of Science and Technology (Wuhan, China) and the University of Florida (Gainesville, FL, USA) in Applied Mechanics and Aerospace Engineering in 1989 and 1993 respectively. In 1997, Dr. Li received a PhD degree in Mechanical Engineering from the Northwestern University (Evanston, IL, USA), and he was also a post-doctoral researcher at the Northwestern University during 1997-2000.

In 2000, Dr. Li joined the faculty of the Department of Civil and Environmental Engineering at the University of California-Berkeley. Dr. Shaofan Li is the recipient of IACM (International Association of Computational Mechanics) Fellow Award [2017]; Distinguished Fellow Award of ICCES [2014]; ICACM Computational Mechanics Award [2013], USACM Fellow Award [2013], A. Richard Newton Research Breakthrough Award [2008], and NSF Career Award [2003]. Dr. Li has published more than 140 articles in peer-reviewed scientific journals (SCI) with h-index 43 (Google Scholar), and he is also the author of two research monographs/graduate textbooks.