ICAMS Special Seminar

Monday, 7 January 2020
Room IC FW 02/718, 10:30 a.m.

Prof. Dr. Junjie Zhang

Harbin Institute of Technology, Center for Precision Engineering

Material-oriented ultra-precision machining: case studies of polycrystalline metal and reaction-bonded ceramic

Fundamental understanding of microstructural influences and their correlation with macroscopic machining results is essential to improve achievable ultimate machining accuracy of materials. In this talk, we report recent advances in numerical simulations and experiments of diamond cutting of polycrystalline copper and reaction-bonded silicon carbide. For the ductile metallic material, a crystal plasticity based finite element model of diamond cutting of polycrystalline copper is established to characterize the machining anisotropy of the polycrystalline material, which is verified by experiments of nanoindentation, nanoscratching, in-situ SEM diamond cutting and cross-sectional TEM characterization. In particular, the formation mechanism and suppressing strategy of grain boundary surface steps are emphasized. For the hard and brittle ceramic material, the brittle-to-ductile transition behavior in ultrasonic elliptical vibration-assisted diamond cutting of reaction-bonded silicon carbide is revealed by finite element simulations and experimental validations. The geometrical features of silicon particles in silicon carbide matrix are assigned according to realistic microstructural characteristics of the two-phase condense composite material. In particular, the tool-particle interaction and its influence on the machined surface formation are revealed. The above work provides insights into the influence of material properties and internal microstructures on the formation of ultra-smooth surface by ultra-precision machining.

Biography: Dr. Junjie Zhang currently is a full-position professor of mechanical engineering in Center for Precision Engineering, Harbin Institute of Technology, China. He received his B.S., M.S., and Ph. D. degrees from Harbin Institute of Technology of China in 2005, 2008, and 2011, respectively. He acted as a visiting student and a postdoctoral researcher in Prof. Alexander Hartmaier research group in the Interdisciplinary Centre for Advanced Materials Simulation (ICAMS), Ruhr-University Bochum in 2009 and 2012, respectively. Dr. Junjie Zhang has a background in mechanical engineering and computational materials science. His current research interests are focused on fundamental of material-oriented ultra-precision machining, design and fabrication of functional microstructures, laser micromachining, computational materials science, etc.