

Title: Failure Mechanisms and Simulation Methods of Rock Slopes under Extreme Environmental Conditions

Abstract: Landslides, as highly destructive geological hazards, pose significant threats to human lives, property, and engineering safety. The evolution mechanism of slope instability is complex, involving both a progressive failure process from continuum to discontinuum and a cross-scale evolution from micro-cracks to macro-fractures. Conventional simulation methods struggle to fully capture the entire landslide process. To address this, we developed the FDEM-Slope method, enabling comprehensive simulation of the progressive failure evolution of slopes, including dynamic processes from initiation and instability to sliding and deposition, as well as complex behaviors like rock fragmentation, sliding, overturning, and collision. Additionally, the impacts of groundwater fluctuation and ice expansion effects on slope stability under extreme climate conditions are discussed.

Bio: Dr. Lei Sun is a Professor at Wuhan University. He received his Ph.D. in Geotechnical Engineering from Wuhan University in 2020 and conducted postdoctoral research at University of Toronto (2020 – 2024). His research focuses on multiphysics coupling mechanisms and their applications in critical engineering challenges, including slope stability, tunnel deformation, and energy-related geotechnical systems (e.g., geothermal energy extraction and oil/gas reservoir engineering). He has published over 30 peer-reviewed journal papers in these fields.

