STRUCTURAL MECHANICS

RUB

Master's Thesis

Numerical implementation of non-local CDPM2 model and investigation of mesh sensitivity in structural simulations

Supervisor: Dr.-Ing. Vladislav Gudžulić

Background:

As an alternative to discrete approaches to fracture modeling, non-local continuum damage-plasticity constitutive models are often utilized for large-scale structural simulations due to their advantageous computational efficiency. Continuum models must be regularized using a crack-band approach or non-local formulations to achieve mesh-independent results. The aim of this thesis is the implementation and validation of one such model.

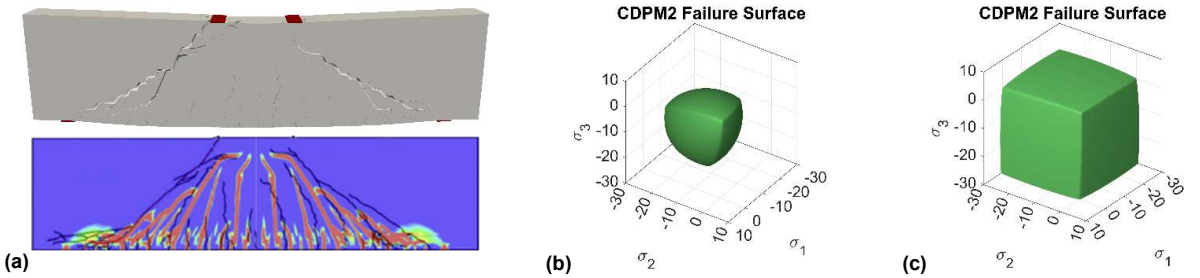

Figure 1: (a) Failure patterns of the RC beam subjected to four-point bending using the discrete approach (above) and continuum damage-plasticity approach (below). CDPM2 failure surface at the onset of (b) inelasticity; (c) damage localization

Tasks:

- Implement the CDPM2 model within an existing in-house finite element code and validate the model through numerical simulations of benchmark examples, including size-effect analyses
- Derive and implement a non-local regularization for CDPM2 and conduct a parametric study to compare mesh sensitivity in local versus non-local formulations
- Discuss theoretical frameworks or conduct preliminary studies on adapting CDPM2 for modeling the breakage of asperities during rough surface contact

Future prospects:

After establishing the reliability of the model, a future study could explore its adaptation to model the asperity breakage in contact analyses of rough concrete surfaces. This work could potentially be continued during PhD studies at the Institute for Structural Mechanics, in the scope of A02 subproject of SFB 1683.

Requirements:

- Strong interest in theoretical development and implementation aspects of computational models for fracture and inelastic behavior of structures
- Above-average academic performance
- Familiarity with and enthusiasm to master programming in MATLAB, Python, and C++

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References:

1. Grassl, P. and Jirásek, M. (2006). "Damage-plastic model for concrete failure." Int. J. Solids Struct. 43(22-23): 7166-7196.
2. Grassl, P. et al. (2013). "CDPM2: A damage-plasticity approach to modelling the failure of concrete." Int. J. Solids Struct. 50(24): 3805-3816.