Peridynamic Modeling of Adaptive Remodeling

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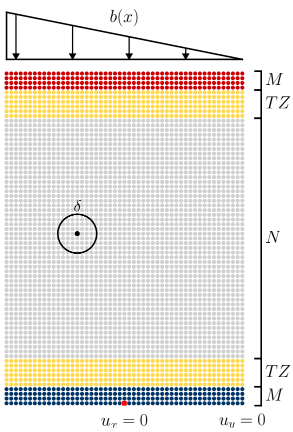
This work presents a bond-based peridynamic formulation of an adaptive remodeling model for density evolution. The study investigates how the nonlocal character of peridynamics affects the numerical response and the evolving density distribution in benchmark problems commonly analysed with the finite element method. The density update follows the approach of Weinans et al. [1]:

$$\Delta\rho_i = C\left(\frac{SED_i}{\rho_i} - k\right) \tag{1}$$

where C is the rate parameter and k denotes the homeostatic set-point. The remodeling stimulus is defined by the strain energy density SED_i obtained from the nonlocal peridynamic solution. The implementation is developed within the open-source PeriLab framework [2] and is based on the theory introduced by Silling [3].

The analysed cases consider a 2D plate subjected to linearly varying loading. The study examines the influence of the nonlocal interaction radius, the stiffness averaging rule, and the evolution parameters. Particular attention is paid to numerical challenges related to the nonlocal formulation, including the sensitivity of the energy field and the stability of the evolving response. Preliminary results indicate that both the nonlocal modeling choices and the evolution parameters strongly affect the smoothness of the obtained fields and the emerging density patterns. The presented work is part of an ongoing study aimed at establishing a robust peridynamic framework for remodeling-driven structural evolution.



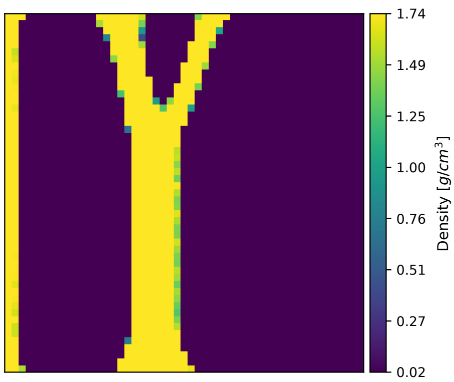


Figure 1: Left: analysed problem setup. Right: representative converged density distribution for one analysed parameter set.

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