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Modeling and discretization of slender continua and their interaction

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Highly slender fiber- or rod-like structures can be found in a variety of different physical problems, for example classical engineering applications (e.g., ropes, fiber-reinforced composite materials), but also biological systems (e.g., Brownian dynamics within the cytoskeleton of biological cells) or biomedical devices (e.g., stent grafts for endovascular aneurysm repair). By exploiting the fact that one spatial dimension of these slender structures is large compared to the other ones, they are often modeled as 1-dimensional Cosserat continua based on the geometrically nonlinear beam theory.

For all mentioned examples, mechanical interaction between the individual system components, i.e., rods interacting with other rods (beam-to-beam) and rods interacting with higher dimensional structures (beam-to-surface or beam-to-volume), crucially influences the overall system behavior. Systems of this type are typically characterized by a large number of individual 1-dimensional structures. Consequently, such systems provide considerable challenges for numerical solution schemes and state highest requirements with respect to computational efficiency and robustness. The proposed mini-symposium intends to bring together scientists from different disciplines of computational mechanics and foster scientific exchange and collaboration in innovative research. Contributions focusing on modeling and discretization approaches for slender continua and their interactions, both from method development and application point of view, are invited. Topics of interest include, but are not limited to:

- Geometrically nonlinear theories for slender continua (classical Simo-Reissner and Kirchhoff-Love beam theories, beam theories accounting for cross-section deformation or composite cross-sections, reduced beam or rope models etc.)
- Finite element formulations for geometrically nonlinear beam problems (geometrically exact, co-rotational, ANC or solid beam element formulations etc.)
- Alternative discretization schemes for 1D continua besides the FEM (FDM, IGA, etc.)
- Parametrization, spatial interpolation and time integration schemes for large rotations
- Modeling and discretization approaches for beam-to-beam contact interaction
- Modeling and discretization approaches for beam-to-surface and beam-to-volume interaction
- Modeling and discretization approaches for multi-physics beam interactions (e.g., beam-to-fluid)
- Modeling of mechanical systems involving fibers / slender continua in fields of application reaching from classical engineering problems to biomedical / biophysical systems to computer graphics
- Efficient and robust numerical solution schemes for beam interaction problems (e.g., efficient evaluation of the interaction terms, contact search, physics-inspired linear / nonlinear solvers for large-scale problems)
- Experimental mechanics and constitutive modeling for slender flexible continua

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