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ADVANCES IN THE MODELING AND DISCRETIZATION OF SLENDER CONTINUA AND THEIR INTERACTION

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ABSTRACT

Highly slender fiber- or rod-like components represent essential constituents of mechanical systems with a wide variety of applications in very different areas. Examples are high-tensile industrial ropes as utilized e.g. in urban ropeway transport systems, heavy duty textile webbings, fiber-reinforced composite or synthetic polymer materials. On entirely different time and length scales, such slender components are relevant when analyzing the supercoiling process of DNA strands, the characteristics of carbon nanotubes or the Brownian dynamics within the cytoskeleton of biological cells. Often, these slender mechanical members can be modeled as 1D Cosserat continua based on a geometrically nonlinear beam theory. For all

mentioned examples, mechanical contact interaction crucially influences the overall system behavior. Systems of this type are typically characterized by a large number of such components within representative volume elements, arbitrary orientations and curvatures as well as high slenderness ratios of these components. Consequently, such systems provide considerable challenges for numerical solution schemes and state highest requirements with respect to computational efficiency and robustness.

Following the successful first meeting at the ECCM Conference in Glasgow in 2018, the proposed mini-symposium intends to continue the fruitful discussions between scientists from different disciplines of computational mechanics in a workshop-like atmosphere. Again, 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, corotational, 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 multi-physics beam-to-beam interactions (e.g. due to inter-molecular potentials such as van der Waals forces, electrostatic /-dynamic interactions etc.)
- Modeling and discretization approaches for the coupling between 1D and 3D continua
- Modeling of mechanical systems involving fibers / slender continua in fields of application reaching from classical engineering problems to biomedical / biophysical systems to computer graphics