"Numerical approaches for PDEs on surfaces"

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We will focus on vector- and tensor-valued surface PDEs, e.g. surface flows [1] and surface liquid crystal models [2,3]. In contrast to numerical methods for scalar-valued surface PDEs which only require small modifications of established approaches, new questions arise for vector- and tensor-valued problems: How to define two tangential vectors on a triangulated surface to be parallel? What properties are required for a tangential surface tensor? What is an appropriate vector surface Laplacian? How to deal with topological defects (singularities) in tangential vector fields? How to transport a tensor quantity on an evolving surface? We will derive the models as thin-film limits of the corresponding 3d models, consider an appropriate material derivativ, introduce numerical tools and study phenomena which couple the topology and geometric properties of the surface with the dynamics of the field on it.

[1] S. Reuther and A. Voigt. Solving the incompressible surface Navier-Stokes equation by surface finite elements. Phys. Fluids, 30:012107, 2018
[2] M. Nestler, I. Nitschke, S. Praetorius, and A. Voigt. Orientational order on surfaces - the coupling of topology, geometry and dynamics. J. Nonlin. Sci., 28:147, 2018.
[3] I. Nitschke, M. Nestler, S. Praetorius, H. L öwen, and A. Voigt. Nematic liquid crystals on curved surfaces - a thin lm limit. Proc. Roy. Soc. London A, DOI:10.1098/rspa.2017.0686