A nonsmooth geometric approach for system-level modelling of braiding process

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The production of braided preforms by simultaneous deposition of warp and weft (optionally stem) textile yarns on a mandrel constitutes the initial stages of composite manufacturing. Commonly known as circular overbraiding, the system-level modelling of such processes ideally involves the development of a consistent framework to model the bobbin carrier kinematics, highly slender yarns as deformable beams and frictional contact interactions with the mandrel together in a unified, robust and efficient setting.

In this project, a differential geometric approach is proposed to model the different components of the machine. More precisely, the absolute motion of each component is mathematically represented using homogeneous transformation matrices defined on the Lie group $SE(3)$. The joints which connect the different components are then modelled as bilateral constraints so that the equations of motion take the form of a differential-algebraic equation (DAE) on a Lie group.

This talk addresses in particular the modelling of the transfers of a bobbin carrier to subsequent horn gears as a bilateral constraint with switching conditions. The deformable beam is then connected to the carrier to study its response with nonsmooth boundary conditions arising from the transfers. We will further investigate the behaviour of a nonsmooth time integration scheme in this setting.