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A Spline-Based Framework for Microscopic Lubricated Contact Modelling in Orthogonal Cutting

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In orthogonal cutting, product quality and tool life are closely related to tribological interactions between workpiece and tool. Experimental results show that lubrciated contact zones result in better product quality and tool life. Furthermore, they also show that the mechanisms of these interactions depend strongly on the surface topography of tool. To this end, this work aims to develop a framework to investigate the key effects within the lubricated contact zone on a microscopic level.

The presented framework utilizes splines for both the geometric modelling of the microscopic lubricated contact zone and numerical anaysis thereof. There are three major components: (1) fluid solver, (2) structural solver, and (3) geometry processor. Both fluid and structural solver employ spline-based finite element methods (FEM): NURBS-Enhanced FEM (NEFEM) and Isogeometric Analysis (IGA) respectively. Two individual solvers are coupled using a partitioned approach; however, with identical spline-representations of the interface. The task of the last part of the framework, the geometry processor, is to generate spline geometries for both solvers. In order to generate realistic computational domains, spline-fitting is performed on the actual measurements of surface topography.

With the aforementioned framework, we investigate the interactions between lubricants, tool and workpiece. The results can serve as basis for the derivation of a characterized friction model for macroscopic chip-formation simulations.

REFERENCES

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