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Contact modeling of conformal surfaces subjected to microslips in spline applications

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Abstract

Splines allow for the adaptation of shaft length for the transmission of low to high amplitude torques at low to high rotational velocities. Splines are commonly used in transmissions for high power in various fields such as industry, aeronautics, maritime, and terrestrial transportation. The length adjustability provided by splines results in sliding zone between conform surfaces submitted to contact pressures. Lubrication is thus crucial. Microslips result in fretting of the contact surfaces. One major factor affecting spline lifespan is shaft misalignment. Misalignments amplify microslips, accelerate fretting, and thus lead to premature wear. These mechanisms are still difficult to include in simulation models. Thus accurately predict the lifespan of splines subjected to misalignments remains challenging. A deeper understanding of these phenomena is essential to improve the precision and reduce the calculation time of the currently available modeling methods. Improving the simulation approaches should help to avoid premature failure and to increase the spline lifespan by ensuring better designs, better adapted lubrication and better maintenance planning. Therefore, the present study aims to develop a numerical model of conformal contacts inherent to splines. The proposed contact algorithm relies on Boussinesq theory. Indeed, the half-space simplification ensures high precision and reduces calculation times. This strategy also allows including the roughness of the contact surfaces. In addition to the transmitted torque, the model under development should include spline manufacturing errors as well as shaft misalignments causing micro and macro-slips and, thus shear forces as well as the spline teeth bulk deformations. The current state of the art indicates that several spline contact models already exist but do not account for shaft misalignment. The lecture should concentrate on the contact algorithm proposed to model contacts between conformal surfaces under microslip conditions.