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# Finite element modelling of fretting wear using an adaptive cycle jump

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Wear is a surface degradation process that results in material removal. It can be induced by many types of relative motion between contacting surfaces. Among them, fretting refers to small amplitude oscillatory motion. Fretting wear occurs in various industrial contexts and can significantly reduce the lifetime of industrial components. Because it depends on a large number of physical and chemical parameters, wear is a complex phenomenon to be modelled. This explains why experiments are often carried out to investigate wear behaviour. This work focuses on the numerical simulation of fretting wear between 316L and 304L austenitic stainless steels, which is meant to represent wear occurring between control rods and guide cards in nuclear reactors. The results are compared with experimental data from previous work by Marc et al. [1, 2].

The first attempts to simulate wear problems with finite element analyses relied on the widely used Archard's wear law. More recently, some authors proposed to use an energy-based wear law relating the worn volume to the energy dissipated by friction [3].

This work focuses on the simulation of wear evolution on a cylinder and a half-plane in frictional contact using a two-dimensional plane strain finite element model. A fretting motion is imposed and, at each time step of the computation, the field of dissipated energy per unit area is computed. The accumulated dissipated energy over a fretting cycle yields an incremental wear depth profile which is applied on the surface through a nodal displacement technique. In order to mitigate the computational cost, a cycle jump technique is used. Traditionally, a constant user-defined acceleration factor is used over the whole computation. Here, an original method for the determination of the acceleration factor is proposed. It is based on an estimation of the wear profile enlargement rate. The faster the wear profile is expected to widen, the lower the acceleration factor will be.

Numerical results show good agreement with the experimental data. However, unexpected fluctuations are observed on the computed stresses when high acceleration factors are reached. These undesired fluctuations can end up spoiling the computed wear profile. They are likely related to the contact formulation that appears to be inaccurate in some cases. Ongoing research are related to the improvement of contact conditions enforcement for predicting smooth wear kinetics.

## References

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