# TRIBOLOGICAL INVESTIGATION ON A GREASED CONTACT SUBJECTED TO CONTACT DYNAMIC INSTABILITY

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## ABSTRACT
Considering mechanical systems with two surfaces in contact and in relative motion, during the sliding of one body over another, friction induced instabilities and stick-slip intermittent motions can occur [1, 2, 3]. In this case, the sliding is not continuous, but instead proceeds with a series of "sticks" and "slips" [4, 5]. These forms of vibration are often undesirable and can cause excessive wear of components, surface damage, fatigue failure, and noise [2, 3, 5]. The problem becomes even more complicated when lubricated contact interfaces are involved, as in this case of study. Nowadays, in literature few works deal with stick-slip in lubricated systems [6, 7]. In the present work, a systematic approach to the stick-slip problem of a greased contact is proposed, by identifying the tribological triplet and analysing the parameters that most influence the appearance of the phenomenon, using together surfaces analysis, with experimental and numerical dynamic simulations.

Considering the specific application of a mechanical spring-brake, used in electric tubular actuators, the lubricated contact of the parts in relative motion is here analysed. The possible instability appearance (i.e. stick-slip phenomena) of such contact is the result of the coupling between the system dynamics and the frictional response of the parts in greased contact. The components under examination can be schematized by a torsional spring rotating and sliding on the inner surface of a cylinder. The topological analyses showed an axial movement of the spring, with consequent misalignment of the nearby mechanical parts, when stick-slip occurs. This singular behaviour of the first bodies can cause the dynamic system conditions that accommodate the appearance of the stick-slip. Following the identification of the phenomenon and the components involved, the frictional response of the greased contact is investigated. The local frictional response has been characterized by experimental tests carried out on a specific tribometer, reproducing the as close as possible the operating parameters of the system. The local contact conditions bringing to stick-slip are then investigated. The local frictional response is coupled with the system dynamics by lumped numerical simulations, in order to better evaluate the unstable dynamic response of the system (i.e. the stick-slip phenomena) and identify the parameters that most influence its appearance.

In conclusion, as underlined thought this work, lubricated systems are supposed to reduce the frictional losses, but they can also generate undesirable vibrations. Understanding the conditions for which the system is more predisposed to the stick-slip phenomenon may allow for preventing the appearance of such instabilities in spring-brake design.

## REFERENCES
[1] D. Tonazzi, et al., Role of damping on contact instability scenarios, 5° World Tribology Congress, Italy, 2013.
[2] C. Gao, et al., Fundamentals of stick-slip, Wear, 1993, 1139–1149.
[3] F. Massi, et al, Simulation of dynamic instabilities induced by sliding contacts, DINAME, Brazil, 2013.
[4] D. Tonazzi, et al., Experimental and numerical analysis of frictional contact scenarios: from macro stick–slip to continuous sliding, Meccanica, 50, 2015, 649–664.
[5] J. B. Sampson, et al, Studies in Lubrication: XII. Friction Behavior During the Slip Portion of the StickSlip Process, J. of Applied Physics, 14, 1943, 689-700.
[6] J.-J. Sinou, et al., 'Friction-induced vibration of a lubricated mechanical system', Tribology International, 61, 2013, 156–168.
[7] J. Zuleeg, Controlling Stick-Slip Noise Generation with Lubricants.