

Control of Machines with Friction,
by Brian Armstrong-Hélouvry, Kluwer Academic Publishers,
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Reviewed by Andres Soom¹

Tribologists are accustomed to thinking in terms of the steady state behavior of sliding or rolling contacts with respect to load-carrying capacity, wear, and overall energy losses to friction. Although time-varying behavior is important in many applications, our ability to model such behavior, particularly during transitions between boundary, mixed, and full film lubrication, remains limited. One application area of considerable technological importance is motion and force control, wherein smooth and accurate actions may need to be achieved, during acceleration from rest and at low speeds. This timely

and readable monograph by Professor Armstrong-Hélouvry, is directed toward friction modeling for such applications.

The treatment, which draws extensively from both the tribology and control engineering literature, combines experiments and comprehensive mathematical models to describe stick-slip behavior of a robot arm. However, the work has broader implications to transient friction modeling and points the way to a number of research topics relevant to control and other dynamic applications involving lubricated friction.

It is shown how three effects: (i) the micro-slip region preceding gross slip (called the Dahl effect, here), (ii) a dwell-dependent static or break-away torque, and (iii) temporal delays between changes in sliding speed and corresponding changes in friction cause deviations from steady friction behavior and influence the overall dynamic behavior of the system. A perturbation analysis that agrees with measured occurrence of stick-slip provides persuasive evidence of the roles played by these effects.

Although this monograph cannot be considered to be a definitive work on the topic, it should be read by all tribologists interested in time-dependent friction phenomena.

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