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QUASISTATIC FRICTIONAL CONTACT AND WEAR OF A BEAM

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Abstract. A problem of frictional contact between an elastic beam and a moving foundation and the resulting wear of the beam is considered. The process is assumed to be quasistatic, the contact is modeled with normal compliance, and the wear is described by the Archard law. Existence and uniqueness of the weak solution for the problem is proved using the theory of strongly monotone operators and the Cauchy-Lipschitz theorem. It is also shown that growth of the the wear function is at most linear. Finally, a numerical approach to the problem is considered using a time semi-discrete scheme. The existence of the unique solution for the discretized scheme is established, and error estimates on the approximate solutions are derived.

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1. Introduction

Wear in mechanical systems is a major factor in their proper functioning over time. Therefore, considerable effort is being directed toward understanding, predicting and controlling the process. Most of the wear is generated by dynamic contact of parts and components; as an example, consider the wear of car tires resulting from frictional contact with the road. The subject is very important to the automotive industry, in particular, as the warranty periods for cars grow longer and the need to guarantee good vehicle performance is directly related to wear control. Indeed, concentrated efforts aimed at minimizing the wear take place in the design of automotive parts and components.

There exists a very large volume of engineering literature dealing with various aspects of wear. However, general models of frictional contact with wear have been derived only recently from thermodynamic considerations in [25, 26]. A dynamic thermoelastic frictional contact problem with normal compliance and surface wear has been analyzed in [2], and the isothermal