Quasi-Static Hemivariational Inequalities with Applications to Frictional Viscoelastic Contact Problems

Stanisław Migórski
Faculty of Mathematics and Computer Science
Jagiellonian University, Institute of Computer Science
ul. Lojasiewicza 6, 30-348 Krakow, Poland
email: stanislaw.migorski@ii.uj.edu.pl

Abstract

We consider two classes of subdifferential inclusions in a framework of evolution triple of spaces. The first class involves inclusions with a history–dependent term for which we provide an existence and uniqueness result. The proof is based on arguments on pseudomonotone operators and fixed point. Then we specialize this result in the study of a class of history–dependent hemivariational inequalities. Such kind of problems arises in a large number of mathematical models which describe quasistatic processes of contact between a deformable body and an obstacle. To provide an example we consider a viscoelastic problem in which the frictional contact is modeled with subdifferential boundary conditions. We prove that this contact problem leads to a history-dependent hemivariational inequality in which the unknown is the velocity field. Then we apply our result in order to prove the unique weak solvability of the corresponding contact problem.

In the second class of inclusions, we consider time-dependent possibly nonconvex nonsmooth functions and their Clarke subdifferentials operating on the unknown function. First we prove the existence of a weak solution. Then we study the asymptotic behavior of a sequence of solutions when a small parameter in the inertial term tends to zero. We prove that the limit function is a solution of a parabolic hemivariational inequality. Finally, we give an application to a quasi-static viscoelastic frictional contact problem.