Integro-differential sweeping process with Applications

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In this talk, we analyze and discuss the well-posedness of a new variant of the so-called sweeping process, introduced by J.J. Moreau in the early 70's with motivation in plasticity theory. In this variant, the normal cone to the moving set $C(t)$ is supposed to have an absolutely continuous variation, is perturbed by a sum of a Carathéodory mapping and an integral forcing term. The integrand of the forcing term depends on two time-variables, that is, we study a general integro-differential sweeping process of Volterra type. By setting up an appropriate semi-discretization method combined with a new Gronwall-like inequality (differential inequality), we show that the integro-differential sweeping process has one and only one absolutely continuous solution. We also establish the continuity of the solution with respect to the initial value. The results of the paper are applied to the study of non-regular electrical circuits containing time-varying capacitors and nonsmooth electronic device like diodes. A circuit with high-power fractional-order capacitors, diode and inductor is also analyzed. Another application to a frictionless mechanical problem is also provided.

Talk based on the following:

[1] Bouach, A., Haddad, T., Thibault, L.: Nonconvex integro-differential sweeping process with applications. SIAM J. Control Optim., 60, 229-238 (2022).

[2] Bouach, A., Haddad, T., Thibault, L.: On the discretization of truncated integro-differential sweeping process and optimal control. J Optim Theory Appl . 193, 785-830 (2022).

[3] Bouach, A., Haddad, T., Thibault, L.: Integro-differential sweeping process approach to frictionless contact and integro- differential complementary problems. Commun. Optim. Theory. 25 (2023).