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Bifurcations in constrained dynamics

The questions of existence and classification of bifurcation points in a projected dynamics (given by an ODE on a closed convex set arising usually from optimization problems) was studied by various authors so far using either degree theory applied to a variational inequality problem, or using differential inclusions, as introduced by Fillipov.

In our most recent work, we encountered equilibrium problems, such as non-cooperative games, where certain parameters induce a change in their associated constrained dynamics; such changes could be appearance or disappearance of periodic cycles, or changes in the number of equilibrium points, or changes in the behaviour of nearby orbits.

While in the classical theory of smooth dynamical systems, these types of changes are clearly studied using mostly the Jacobian of the involved vector field of an ODE, in a constrained dynamics, the non-smoothness of the right hand side poses problems when we are trying to follow the classical approach.

We show in this talk that a known mathematical problem called an evolutionary variational inequality (currently used often in time-dependent equilibrium problem formulations) lends itself as a potential straight forward tool in answering the question of existence of bifurcation values for parameters in a constrained dynamics. We give criteria and examples of how bifurcation questions can be tackled in this context.