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Geometry and control of constrained electrostatic equilibria

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We deal with equilibrium configurations of points with Coulomb interaction confined to a compact submanifold of Euclidean space. The first aim is to obtain a geometric characterization of configurations which can serve as stable equilibrium configurations of certain point charges placed at the given points. We will present such a characterization in certain cases where the number of charges does not exceed five. The next aim is to describe the dynamics of such equilibria under the change of values of stabilizing charges and identify arising typical bifurcations. It will be shown that, in particular, the pitchfork bifurcation is typical in the case of the so-called charged necklace in the sense of P.Exner, i.e., for point charges confined to a flexible contour of fixed length. Finally, we will show that in many cases the set of constrained equilibria is path-connected and one may achieve a robust control of stable equilibria by properly changing the values of stabilizing charges. Some applications to the control of vertex-charged mechanical linkages and Coulomb control of satellite swarms will be also outlined. The presentation is based on a few recent joint papers with G.Panina and D.Siersma.