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Controllability and optimal control of multiparticle system: geometric approach

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Abstract

Differential geometric/Lie algebraic control theory, is aimed towards studying various problem settings (such as controllability, observability, structural properties, optimal control) for nonlinear control systems. Central idea of the theory is that the properties of the systems are encoded in the structure of the Lie algebra, generated by the vector fields which form the control system. This fact admits rigorous formulation and is a consequence of the results by T. Nagano and H. Sussmann. It is rather clear that the problem is more complex whenever the number of the controlled fields (the dimension of the input) is small in comparison with the dimension of the state. In the contribution we employ methods of geometric control for studying system of N interacting particles on a straight line (e.g. Toda lattice), under forcing which is applied just to 2 particles. We establish some structural properties of the control system and provide results on controllability and on structure of time-optimal control. We end up providing some comments on controlling other types of nonlinear equations of mathematical physics.