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Minimum-Switch Motion Planning with a Discrete Set of Vector Fields. Preliminary report.

For a class of underactuated mechanical systems, trajectory planning can be reduced to the computationally simpler problems of path planning followed by time scaling. The path must follow the integral curves of a small number of "decoupling" velocity vector fields with zero-velocity switches between them. Thus the path planning problem becomes the problem of choosing the sequence of vector fields to follow, and the times spent following each of them. For systems with an n-dimensional configuration space, in general at least n motion times are necessary to reach the goal. Motion planners yielding paths with this property are called "switch-optimal." These motion planners do not satisfy the "weak topological property" of Laumond et al., however, meaning that as the distance from the start to the goal goes to zero, the travel times may not also go to zero. At least $n+1$ motion times are necessary for this property, and this property is necessary to be able to transform arbitrary collision-free paths to feasible paths. In this talk I will describe this property for kinematic motion planners, give examples that satisfy this property, give exact results on the number of motions necessary for low-dimensional systems, and pose some open questions. (Received August 25, 2004)