A SUFFICIENT CONDITION FOR CONTROLLABILITY OF A SPECIAL CLASS OF POLYNOMIAL SWITCHED SYSTEMS

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A switched system is a hybrid dynamical system consisting of a family of subsystems. Such system possesses a rule that describes how the subsystems switch among them. Many such systems encountered in actual practice exhibit switching among several subsystems which depends on various physical phenomena. Even though much research has been focused on switched control systems in recent years, the issues pertaining to nonlinear switched systems have not been addressed. A fundamental requirement for the design of feedback control systems is the knowledge of structural properties of the plant under consideration. These properties are closely related to the generic properties such as controllability. In this endeavor, a direct approach has been taken to establish a sufficient condition for controllability of switched systems consisting of time-invariant odd-degree polynomial subsystems.

The full rank condition of the Strong Accessibility Lie Algebra of a nonlinear system implies the local controllability of the system at the origin. The Brunovsky's condition implies that a nonlinear control systems consisting of an odd-degree homogeneous drift vector field is globally controllable if its Strong Accessibility Lie Algebra has the full rank. The theory of Strong Accessibility Lie Algebra of odd-degree polynomial systems together with the lines of proof of the necessary and sufficient condition for controllability of linear switched systems are used to prove the result established in this work.

In this attempt, it is shown that, by employing the nonlinear switched system of our interest, any arbitrary state x_0 in the state space R^n can be steered to the origin in the following manner. First, the state is steered to a proper submanifold M_1 of R^n. Then a switching takes place which eventually drives the state to a manifold M_2 which is properly contained in M_1. It is shown that, by continuing this process, the state can be steered to the origin in finite number of switching among subsystems.

Control design for nonlinear switched control systems is known to be a nontrivial problem. In this endeavor, we have successfully laid the groundwork in obtaining a condition for controllability of nonlinear switched systems. The aforementioned direct approach that has been taken in this work, will hopefully lead to establish a sufficient condition for controllability of a broader class of nonlinear switched systems.