The connection between different static state feedback linearizability conditions of discrete time nonlinear control systems

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Two dual sets of necessary and sufficient conditions for static state feedback linearizability of a discrete time control system have been compared. The connection between two methods for state coordinate transformations, corresponding to dual linearizability conditions, has been proved.

The first, geometric set of conditions (Grizzle) is stated in terms of a sequence of nested distributions of vector fields associated with control system. The second, algebraic set of conditions (Aranda-Bricaire, Kotta, Moog) is given via a decreasing sequence of subspaces of 1-forms. The main purpose is to compare the linearizability conditions and the procedures to construct the new state coordinates in order to systematize the knowledge, and analyze both methods from the implementation point of view in the computer algebra systems like Mathematica or Maple.

Our motivation comes from the fact that feedback linearization has proved to be a tremendously useful tool in nonlinear systems and control, but even if a system is feedback linearizable, it can sometimes be extremely difficult to construct the exact feedback linearizing transformation. Our future task is to accommodate also the results of of static state feedback linearization into the united framework.

In order to demonstrate the connections between the algebraic and geometric linearizability conditions it has been shown, that from the involutivity and the constant dimensionality of the nested distributions of the vector fields follows the integrability and the constant dimensionality of the corresponding subspaces of 1-forms. Then the corresponding dual methods of finding the new state coordinates have been compared - via finding the canonical parameters of vector fields, and via integrating the dual 1-forms.