Feedback linearization of possibly non-smooth control systems using 'functions' algebra'

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An algebraic method called 'functions' algebra', which is based on the algebra of partitions [1], will be used to linearize a discrete-time control system by a state feedback and change of coordinates. The advantage of this method over other existing methods is that it allows also to consider systems described by non-smooth functions. The main objects we work with are vector functions. These vector functions are divided into the equivalence classes on the basis of partial preorder, which defines an equivalence relation. The partial preorder acts on the set of equivalence classes as partial order and thus the set of equivalence classes becomes a lattice. This lattice is connected to the system description

$$\begin{aligned} x(t+1) &= f(x(t), u(t)) \\ x(t) &\in \mathbb{R}^n, \quad u(t) \in \mathbb{R}^m, \end{aligned}$$

by certain binary relation Δ. Necessary and sufficient conditions are found for the existence of a coordinate transformation $z(t) = \varphi(x(t))$ and a static state feedback $u(t) = G(x(t), v(t))$, $v(t) \in \mathbb{R}^m$, such that in coordinates $z(t)$, after applying the feedback, the system equations are linear.

References

[1] J. Hartmanis and R. Stearns, *The algebraic structure theory of sequential machines*, Prentice-Hall, New York, 1966.