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COMPUTATION OF STATE REACHABLE POINTS OF SECOND ORDER LINEAR TIME-INVARIANT DESCRIPTOR SYSTEMS*

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Abstract. This paper considers the problem of computing the state reachable points (from the origin) of a linear constant coefficient second order descriptor system. A new method is proposed to compute the reachable set in a numerically stable way. The original descriptor system is transformed into a strangeness-free system within the behavioral framework followed by a projection that separates the system into different order differential and algebraic equations while keeping the original state variables. This reformulation is followed by a first order formulation that avoids all unnecessary smoothness requirements. For the resulting first order system, it is shown that the computation of the image space of two matrices, associated with the projected system, is enough to numerically compute the reachable set. Moreover, a characterization is presented of all the inputs by which one can reach an arbitrary point in the reachable set. These results are used to compute two different types of reachable sets for second order systems. The new approach is demonstrated through a numerical example.

Key words. Linear time-invariant descriptor system, Behavior formulation, Strangeness-free formulation, Reachability, Derivative array, Second order system.

AMS subject classifications. 93C05, 93C15, 93B05.

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