

Impulsive solutions in LTI dynamical systems have received ample attention, but primarily for descriptor systems, i.e., first order Differential Algebraic Equations (DAEs). This paper focuses on the impulsive behavior of higher order dynamical systems and analyzes the causes of impulses in the context of interconnection of one or more dynamical systems. We extend the definition of impulse-controllability to the higher order case. Amongst the various nonequivalent notions of impulse-controllability for first order systems available in the literature, which mostly rely on the input/output structure of the system, our definition, based on a so-called state-map obtained directly from the system equations, generalizes many key first order results to the higher order case. In particular, we show that our higher-order-extension of the definition of impulse controllability generalizes the equivalence between impulse controllability and the ability to eliminate impulses in the closed loop by interconnecting with a suitable controller. This requires an extension of the definition of regularity of interconnection from behaviors involving only smooth trajectories to behaviors on the positive half line involving impulsive-smooth trajectories.