On algebraic time-derivative estimation and deadbeat state reconstruction

In the past few years, the algebraic approach to estimation in control systems proposed by Fliess and co-workers has generated a number of interesting results for different problems of estimation of dynamical systems such as state estimation, parametric identification, and fault diagnosis, to name but a few. Loosely speaking, this new estimation approach is mainly based on the robust computation of the time-derivatives of a noisy signal by using a finite weighted combination of time-integrations of this signal. These results, obtained through the use of differential algebra and operational calculus, allow to obtain an estimate of the time-derivative of a particular order in an arbitrary small amount of time. Questions arise on how to relate the above to more classical results of automatic control, and in particular to linear system theory. The lecture contributes to this discussion by showing that the algebraic time-derivative estimation method can be seen, in a sense, as a special case of previously known state-space results exhibiting a deadbeat property. The coincidence in this case is proved resorting to a modern computer algebra proof technique.