Xie, L. B.; Shieh, L. S.; Tsai, J. S. H.; Wu, C. Y.; Park, J. J.
Digital and analog integer delayed modeling and control for multivariable systems with multiple time delays in states, inputs and outputs. (English) Zbl 1446.93008

Summary: This paper presents a new approximated integer delayed modeling and control technique for Continuous-time Fractional Delay Differential Equations (CFDDEs). Using the impulse response sequences of the CFDDE and the balanced model-reduction method, a delay-free discrete-time state-space model is constructed. Then, an equivalent Discrete-time Integer Delay Difference Equation (IDDDE) is obtained by transforming the obtained discrete-time state-space model into a controller-type block companion form. Furthermore, based on the obtained DIDDE, an equivalent Continuous-time Integer Delay Differential Equation (CIDDE) is determined by means of the newly developed Chebyshev’s bilinear approximation method. For digital control of the CFDDE, an optimal Discrete-time Integer Delayed Control Law (DIDCL) is designed using the conventional discrete-time LQR approach together with the obtained delay-free discrete-time state-space model. On the other hand, for continuous-time control of the CFDDE, a Continuous-time Integer Delayed Control Law (CIDCL) is determined from the designed DIDCL by means of the inverse Chebyshev’s bilinear approximation method. Finally, digital and analog integer delayed observers are constructed for the implementations of the developed DIDCL and CIDCL, respectively. An illustrative example is given to demonstrate the effectiveness of the proposed method.

MSC:
93-10 Mathematical modeling or simulation for problems pertaining to systems and control theory
93C05 Linear systems in control theory
93B07 Observability

Keywords:
multiple time delays; integer delayed model; integer delayed control; balanced model-reduction method; step response data

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