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BALL-BEAM SYSTEM MODELING USING NONLINEAR STATE-SPACE EQUATIONS APPROACH AIDED BY BOND-GRAPHS

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ABSTRACT

This work presents a general and computational algorithm applied to develop the nonlinear state-space equations associated to the beam-ball dynamic system, using Bond-Graphs techniques. The choice of modeling techniques to be applied on nonlinear system is still a question without a definitive answer. In this way, the presented algorithm is used to a class of nonlinear systems. The system equations are developed and treated using the Toolbox in MATLAB environment. A computational model with confidence is obtained and it is useful on control system design and to analyze effects of nonlinear dynamics.

If data or important information about the system is available, it can be a determinant element in the definition of its correct mathematical system representation. Thus, it allows incorporating previous information to the modeling process and facilitates the nonlinear system identification. It is presented the developing of nonlinear state-space equations associated to the beam-ball dynamic system, consisting of a ball that can roll freely through a beam, controlled by a stepper motor. The application, implementation and numerical results are presented in details and classes of nonlinear system that can be used with this approach are discussed.

The correct separation of derivative and integrative causalities on the model, in a simple form using Bond-Graphs leads to a systematic procedure that can simplify the modeling and identification process. The validation of the computer algorithm results on applications to other nonlinear systems with confidence, mainly in cases that nonlinear state-space are developed and treated using symbolic mathematical software.

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