Summary: This work focuses on the model order reduction problem for bilinear control systems with nonzero initial conditions. Based on the Volterra series analysis, the system response can be decomposed into three parts. The first two parts are the zero input response and zero initial condition response of the system. The third part describes the response which couples the effect of the nonzero initial condition and the nonzero input. The system corresponding to the third part is a bilinear control system with a special time-varying input coefficient matrix. We show that such a system is equivalent to a time-invariant bilinear control system, and conventional model reduction methods can be applied to reduce it. We propose to reduce each of the component responses independently and then combine them to approximate the full system response. This method is of high flexibility and shows promising results.

MSC:
93B11 System structure simplification
93C10 Nonlinear systems in control theory
93C35 Multivariable systems, multidimensional control systems

Keywords:
model order reduction; bilinear control system; inhomogeneous initial condition; kernel energy averaging; approximation of matrix exponential function

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