International Journal of Dynamics and Control

Volume 5, Issue 1, 2017, Pages 79-94

The solution of state space linear fractionalsystem of commensurate order withcomplex eigenvalues using regularexponential and trigonometric functions

Djamel Boucherm, Abdelfatah Charef, Hassene NEZZARI

Abstract: In a previous work, we have derived the generalsolution of the state space linear fractional system of commensurate order for real simple and multiple eigenvalues ofthe state space matrix. The obtained solutions of the homogeneous and non-homogeneous cases have been expressed as alinear combination of introduced fundamental functions. Inthis paper, the above work has been extended to solve thestate space linear fractional system of commensurate orderfor complex eigenvalues of the state space matrix. First, suitable fundamental functions corresponding to the differenttypes of complex eigenvalues of the state space matrix areintroduced. Then, the derived formulations of the resolutionapproach are presented for the homogeneous and the nonhomogeneous cases. The solutions are expressed in terms ofa linear combination of the proposed fundamental functionswhich are in the form of exponentials, sine, cosine, dampedsine and damped cosine functions depending on the commensurate fractional order. The results are validated by solving anillustrative example to demonstrate the effectiveness of theproposed analytical tool for the solution of the state spacelinear fractional system of commensurate order.

Keywords : Complex eigenvalues · Fractional differential equation · Fundamental functions · Modal decomposition · Rational function · State space representation