

The solution of state space linear fractional system of commensurate order with complex eigenvalues using regular exponential and trigonometric functions

Djamel Boucherm, Abdelfatah Charef, Hassene NEZZARI

Abstract: In a previous work, we have derived the general solution of the state space linear fractional system of commensurate order for real simple and multiple eigenvalues of the state space matrix. The obtained solutions of the homogeneous and non-homogeneous cases have been expressed as a linear combination of introduced fundamental functions. In this paper, the above work has been extended to solve the state space linear fractional system of commensurate order for complex eigenvalues of the state space matrix. First, suitable fundamental functions corresponding to the different types of complex eigenvalues of the state space matrix are introduced. Then, the derived formulations of the resolution approach are presented for the homogeneous and the nonhomogeneous cases. The solutions are expressed in terms of a linear combination of the proposed fundamental functions which are in the form of exponentials, sine, cosine, damped sine and damped cosine functions depending on the commensurate fractional order. The results are validated by solving an illustrative example to demonstrate the effectiveness of the proposed analytical tool for the solution of the state space linear fractional system of commensurate order.

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