α-stability of a class of linear fractional-delay systems

Zaihua Wang[1] and **Xinghu Teng**[1]

[1] *State Key Lab of Mechanics and Control of Mechanical Structures, Nanjing University of Aeronautics and Astronautics, Nanjing 210016, China (e-mail: zhwang@nuaa.edu.cn, tengxh3121@163.com)*

Over the past few decades, fractional-delay systems have drawn much attention from researchers in different fields. In vibration control, for example, fractional-order derivatives are often used for modelling viscoelastic materials that are used as damping materials, and time delay is inevitable in controllers and filters. Stability analysis of a fractional-delay system has been a fundamental problem in many applications. Although fractional systems are generalizations of conventional integer-order systems, they have many different features from integer-order systems. Unlike the solution of a conventional linear system whose asymptotic behavior follows "exponential" rule, for instance, the asymptotic expression of the solution of a fractional linear system follows "power" rule. Thus, the stable solution of a fractional linear system goes to equilibriums slower than that of a conventional linear system, it exhibits "long tail" phenomenon. To achieve a faster stabilization, one way is to make the solution α-stable with a properly chosen positive number α, which requires that all the characteristic roots have real parts less than $-\alpha$. Then, the stability analysis can be changed to the study of root location of a transcendental function with delay-dependent coefficients, for which few results are available in the literature. This talk will discuss the α-stability of a class of fractional-delay systems, and focuses on how the α-stability can be effectively analyzed, and what concise formula in closed form can be obtained for determining the crossing direction of the characteristic roots at the critical delay values.