复杂微分网络的指数稳定性

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摘要　　研究树形弦网络在速度反馈控制下的指数稳定性及其控制器的有效性.
用半群理论证明速度反馈控制下的闭环系统是适定的. 通过对算子谱的渐近分析, 得到在一定条件下,
系统的谱分布在平行于虚轴的带域中, 并证明存在一列根向量构成Hilbert状态空间一个加括号的Riesz基,
从而系统满足谱确定增长条件. 利用Riesz基性质和谱分布, 给出系统的指数稳定性结果.
提出控制器有效性的概念,
给出网络不同节点处控制器的有效性比较, 得到使树形弦网络指数稳定所需控制器的最少个数及其放置位置.

关键词　　树形弦网络, 速度反馈控制, 谱分析, Riesz基, 指数稳定性, 有效控制器.

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The Exponential Stability of Complex Differential Networks

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Abstract In this paper, a tree-shaped network of strings equipped with velocity feedback controllers is considered, and the exponential stability of the closed-loop system is obtained. First, it is shown that the system is well-posed by using the C_0 semigroup method. Then it is proven that the spectra of the system locate in a vertical strip under certain conditions by an asymptotic analysis technique, and that there is a sequence of root vectors that forms a Riesz basis with parentheses for the state Hilbert space. Hence the system satisfies the spectrum determined growth assumption. Then, the Riesz basis property together with the distribution of the spectra of ${\mathcal A}$ asserts that the system is exponentially stable. Finally, a new concept --- the efficiency of the controllers is proposed, with which, the efficiency of controllers at each node of the network is compared and the least number of controllers to make the system exponentially stable is given.

Key words Tree-shaped network of strings   velocity feedback control   spectral analysis   Riesz basis   exponential stability   efficiency of controller.

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