Research

Colloquium

Synchronization of Heterogeneous Forced First-Order Kuramoto Oscillator Networks: A Differential Inequality

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摘　要：

In this talk, we first introduce the basic mathematical theory of the synchronization problems. In particular, we focus on the celebrated Kuramoto model. As an important application, we investigate the synchronization for power networks. Namely, a differential inequality approach is utilized to derive several stability conditions for synchronizing heterogeneous first-order forced coupled Kuramoto oscillator networks. First, we show that if either the amplitude of the external force is large enough or all natural frequencies equal to the external frequency, the heterogeneous first-order forced coupled Kuramoto oscillator network will reach the frequency synchronization for any initial condition. In particular, when all natural frequencies equal to the external frequency, a phase synchronization can be achieved when the amplitude of external force is not zero and the initial configuration is confined to a half circle. For non-identical cases, we show that if the average of all natural frequencies equals to the external frequency, the coupling strength is relatively large compared to the differences of natural frequencies and the amplitudes of external forces, and the initial configuration is confined to a half circle, the heterogeneous first-order forced coupled Kuramoto oscillator network still exhibit a frequency synchronization. Both quantitative and qualitative comparisons with existing synchronization conditions are examined by numerical simulations. These results indicate that these proposed criteria seem to be less conservative. This is joint work with Shih-Hsin Chen, Chia-Chi Chu and Ming-Cheng Shiue.