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探討時變區間延遲基因轉錄調控網路的整體強健時延範圍相關穩定度---線性矩陣不等式法

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摘要

基因轉錄調控網路是細胞內基因之間的相互作用關係的整體表現，是生命功能在基因表達層面的展現。最近利用多種生物信息學（計算分子生物學）工具和高通量實驗技術的發展，使得重建複雜的基因調控網路成為可能。由於基因轉錄調控網路中生物化學反應的時間多尺度性，如 DNA 與蛋白質結合以及蛋白質聚合等快速反應，轉錄翻譯和降解等慢速反應，使得時延現象在基因轉錄調控網路中普遍存在。時延會誘發調控產物的振盪、發散、混沌及不穩定或引起其它基因網路的不好性能。因此本計劃擬提出不確定性時變延遲區間基因轉錄調控網路。利用李亞普若夫泛函適當型來探討時延範圍相關穩定度的問題，提出的結果可以改善存在文獻的結果，主要是因此新方法估測李亞普若夫泛函的微分上限時，不會忽略一些有用的項目。重建時變延遲區間基因轉錄調控網路的工作可以促進在分子和遺傳水平上系統地剖析細胞功能，是功能基因組學中的重要研究內容，我們期盼提出此計

劃能以當前生物信息學為基楚對系統生物學宏觀行為研究作出挑戰性的貢獻。

關鍵字: 系統生物學;基因轉錄調控網路;整體穩定度;時延範圍相關

Globally Robust Delay-Range-Dependent Stability for Transcriptional Regulatory Networks with Time-Varying Interval Delays---An LMI Approach

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Abstract

Transcriptional regulatory networks are the global representation of multiple interactions between genes and their products, which can help us understand the cell's function at the level of gene expression. Recent research advances in multiple bioinformatics (computational molecular biology) and high-throughout experimental technologies have made the reconstruction of transcriptional regulatory networks possible. Time delays are ubiquitous in transcriptional regulatory networks, because of the vast separation of time scales between the fast reactions like DNA-binding and dimerizations, and slow reactions like translation transcription and degradation. The existence of time delay could make delayed transcriptional regulatory networks be oscillatory, divergent, chaotic and instable or have poor performance. Therefore, this project interests have been attracted to the stability analysis for uncertain transcriptional regulatory networks with time-varying delays in a range. An appropriate type of Lyapunov functional is proposed to investigate the robust delay-range-dependent stability problem. The present results may improve the existing ones due to a method to estimate the upper bound of the derivative of Lyapunov functional without ignoring some useful terms and the introduction of additional terms into the proposed Lyapunov functional, which take into account the range of delay. The uncertain transcriptional regulatory networks with time-varying delays in a range can be recreate from available experimental data facilitates the systematic dissection of cell function. The research of the uncertain transcriptional regulatory networks with time-varying delays in a range is an important topic in functional genomics, and one of the most challenging questions in the front of bioinformatics and system biology.

Key words: Systems biology;Transcriptional regulatory networks;
Global stability;Delay-range dependence