Inducible plasmid copy number control and a blueprint for a synthetic genetic feedback optimizer

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Abstract:

The ability to control gene expression has been paradigm shifting for all areas of biological research, especially for synthetic biology. This talk will focus on two recent advancements in gene expression control. First, TULIP (TUnable Ligand Inducible Plasmid) is presented: a self-contained plasmid with inducible copy number control, designed for portability across various *Escherichia coli* strains commonly used for cloning, protein expression, and metabolic engineering. As demonstrated through multiple application examples, flexible plasmid copy number control via TULIP accelerates the design and optimization of gene circuits, enables efficient probing of metabolic burden, and facilitates the prototyping and recycling of modules in different genetic contexts. Second, the blueprint of a genetic feedback module is presented to optimize a broadly defined performance metric by adjusting the production and decay rate of a set of regulator species. The optimizer can be implemented by combining available synthetic biology parts and components, and it can be readily integrated with existing pathways and genetically encoded biosensors to ensure its successful deployment in a variety of settings when relying on mass action kinetics-based dynamics and parameter values typical in *Escherichia coli*.