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Feedback and Modularity in Cell Cycle Control

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Underlying the wonderful diversity of natural forms is the ability of an organism to grow into its appropriate shape. Regulation ensures that cells grow, divide and differentiate so that the organism and its constitutive parts are properly proportioned and of suitable size. Although the size-control mechanism active in an individual cell is of fundamental importance to this process, it is difficult to isolate and study in complex multi-cellular systems and remains poorly understood. This motivates our use of the budding yeast model organism, whose Start checkpoint integrates multiple internal (e.g. cell size) and external signals into an irreversible decision to enter the cell cycle. We have endeavored to address the following two questions: What makes the Start transition irreversible? How does a cell compute its own size? I will report on the progress we have made. Our work is part of an emerging framework for understanding biological control circuits, which will allow us to discern the function of natural systems and aid us in engineering synthetic systems.