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Entrainment of a Synthetic Oscillator through Queueing Coupling[1] PHILIP HOCHENDONER, WILLIAM MATHER, NICHOLAS BUTZIN, CURTIS OGLE, Virginia Tech — Many biological systems naturally exhibit (often noisy) oscillatory patterns that are capable of being entrained by external stimuli, though the mechanism of entrainment is typically obscured by the complexity of native networks. A synthetic biology approach, where genetic programs are wired "by hand," has proven useful in this regard. In the present study, we use a synthetic oscillator in Escherichia coli to demonstrate a novel and potentially widespread mechanism for biological entrainment: competition of proteins for degradation by common pathway, i.e. a entrainment by a bottleneck. To faithfully represent the discrete and stochastic nature of this bottleneck, we leverage results from a recent biological queueing theory, where in particular, the queueing theoretic concept of workload is discovered to simplify the analysis.

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