Understanding Microbial Signaling Through a Communication Theoretic Lens

NSF CIF 1718560

What?

Quorum sensing (QS) is a communication system used by all bacteria to coordinate collective behavior

Goal

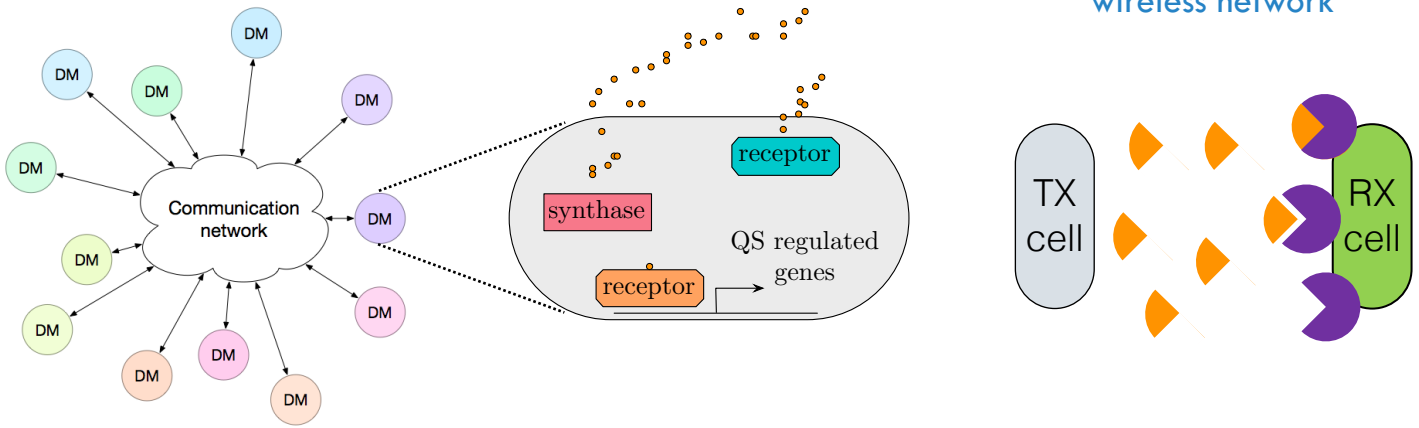
Develop new mathematical models to understand the role, robustness and optimality of QS in bacterial decision-making and validate them using experimental data

In QS the goal is not to send a message with low probability of error, but to make a binary decision under population uncertainty

Bacterial colonies are Networked decision systems

Each cell is a Decision Maker (DM)

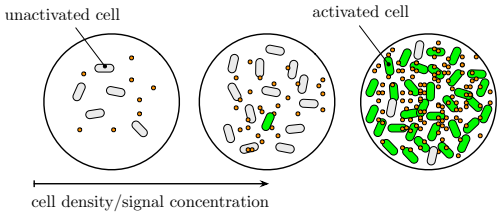
Molecular signals are "broadcast" over a "wireless network"



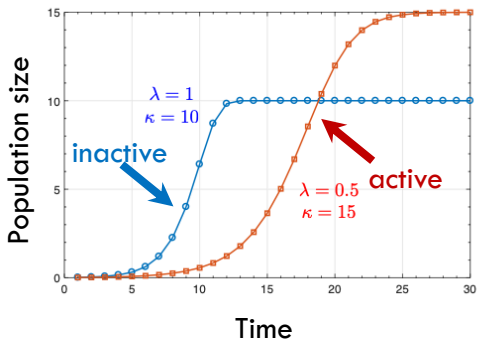
A fundamental QS trade-off:

Activation slows down growth rate but increases carrying capacity

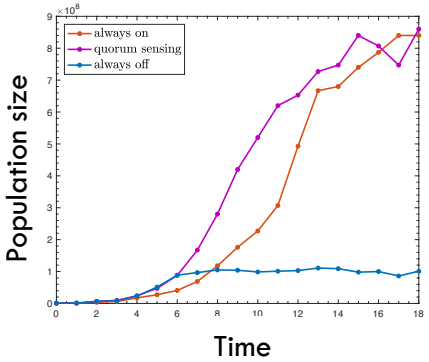
Colony population increases over time



Formulate and solve an optimal control problem akin to economics



QS controls the optimal switch from inactive to active



Our mathematical model match experimental results