BACTERIAL PERSISTENCE: MATHEMATICAL MODELING AND OPTIMAL TREATMENT STRATEGY

By

Nicholas G. Cooper

An Abstract of a Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the Degree of

MASTER OF SCIENCE

Major Subject: ELECTRICAL ENGINEERING

The original of the complete thesis is on file
in the Rensselaer Polytechnic Institute Library

Approved:

A. Agung Julius, Thesis Adviser

Rensselaer Polytechnic Institute
Troy, New York

December 2010
(For Graduation December 2010)

ABSTRACT

The phenomenon of bacterial persistence, although known of for over half a century, has only recently become understood. This phenomena allows for infections from a dormant subset of the population. In this paper a two-state Markov chain hybrid system is proposed to explain the dynamics of long-term persistence of bacteria. The system responds to long-term attacks on the population to survive attacks for an indefinite period. Using this model it is shown that a patterned attacks on the population is more effective in minimizing the number of persistent bacteria. The model is also extended to look for the affects that bacterial resistance would have. Both a state feedback and numerical approach are used to minimize the populations with persistence and resistance traits.