

TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

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Modeling Surface-Volume Reactions for Optical Biosensor Applications

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Abstract.

In a surface-volume reaction, one reactant is dissolved in a fluid which flows over a surface where another reactant is immobilized. These reactions occur in many biological and chemical applications, including optical biosensor devices used to measure reaction rate constants. Early biosensors included only a single reacting zone, but new devices include arrays of reacting zones in a single flow channel.

We discuss a PDE model for the ligand and bound ligand concentrations. For the reaction-limited problem, we use perturbation methods to simplify the full model to a nonlinear ODE model for the average bound ligand concentration in a reacting zone. We present results for a single reacting zone with uniform or nonuniform receptor concentration, as well as for an array of reacting zones having the same or different rate constants. Finally, we use a conformal mapping to relate two-dimensional flow to unidirectional flow within a particular device and compare ligand depletion.