Numerical Techniques in Biomolecule Design and Systems Biology
D. Vasilyev, J. Bardhan, M. Altman, S. Kuo, P. Ramirez, P. Barton, B. Tidor, J. White
Sponsorship: NIH, SMA, NSF

To design an effective drug or a biochemically-based sensor, it is necessary to develop ligand molecules that bind readily and selectively to receptors of interest. Electrostatic forces play an important role in the design of ligands, but the complicated three-dimensional geometry of the problem makes it difficult to assess the electrostatic fields and then optimize the ligand. We have been developing fast methods for electrostatic analysis, and have been focused on three aspects.

First, we have developed a fast analysis program based on using discretized integral equation formulations plus sparsification-accelerated iterative techniques. Second, we have coupled electrostatic analysis with the ligand charge optimization problem using a Hessian-implicit approach [1]. Finally, we have been developing improved discretizations of the molecular surface geometry using curved panels, and have developed approaches for computing integrals over curved panels [2].

REFERENCES:

Figure 1: Electrostatic design problem
Figure 2: Molecular Surfaces for two proteins