

Large-scale simulations of the host response to immune challenge

The immune response to an antigenic challenge like vaccination or exposure to pathogen involves processes occurring over several temporal and spatial scales, from the intracellular signaling events that occur in individual cells within seconds to minutes, to the complex spatial reorganization that occurs in the draining lymph nodes some distance away a few days later. While many of these individual processes have been studied in detail experimentally, there is little understanding of how these add up to produce a coherent immune response, much less the ability to predict outcome in any particular host. Large-scale computer simulations offer a methodology for incorporating data from multiple experimental perspectives (flow cytometry, microarrays, bioassays, histology, two photon microscopy) to construct a consistent model of the immune response. While this approach poses significant software engineering, mathematical and statistical challenges, it remains the only feasible method of producing quantitative, predictive information about the individual immune response. The construction and application of such a large-scale simulation to model the early host response to immune challenge will be described.