Characterization, Modeling, and Simulation of Mouse Microarray Data

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We develop methods for characterizing a set of microarray images and for subsequently simulating microarray images with statistical properties similar to those in the original set. Characterization involved measuring properties of individual spots and performing analysis of variance to determine the relative contributions of individual pins used for printing and individual slides to the variation observed in spot physical properties, slide background properties, and intensity of individual genes. Slide backgrounds and individual spot nonuniformities were modeled as 2D causal Markov random fields, and parameters for these are derived from the set of real images. The results of the characterization were then used to generate realistic replicates of the original dataset that can be used for evaluating microarray data processing and analysis techniques. We demonstrate the process on a set of microarray images derived from a mouse kidney experiment. The characterization of these images showed that slides from two of the six mice have significantly different spot properties from the rest. Simulated images from the set are shown to realistically model most properties of the slides, save for large handling defects. We conclude that characterization should be an important part of any microarray experiment to maintain quality control, and that realistic simulations of microarray images can be produced using these methods.