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Parameter estimation and data reduction for cellular biophysical analysis

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Accurate estimation of cellular permeability parameters are an important part of designing and developing optimized cryopreservation protocols. Electronic Particle Counters measure cell volume by detecting changes in electrical conductivity. However, data that are obtained from these machines are noisy, making immediate application of curve fitting algorithms impossible. We attempted to reduce or eliminate noise due to both the population variance and the instrument. To eliminate the noise we grouped the original data into evenly spaced time bins, compared the point density of each bin to the average density over all the bins, and discarded those bins whose density fell outside a predetermined range that was centered around the average. Next an averaging scheme was created to remove the noise from the top and bottom. This was accomplished by grouping the remaining bins and applying a third order polynomial fit to the high and low ends of their volume histogram. Minima where found for each end in each time bin and their average was used as our high and low cut off. Any remaining noise was eliminated through the use of a Fast Fourier Transform and a high pass filter. After noise reduction a curve was then fit to the remaining data points using a least squares parameter estimation technique and a conjugate gradient method to find optimal parameters of the differential equations which model cell volume flux. These parameter values that were acquired using the best fit technique could then be used in models to more accurately represent the data that was collected.