Development of Computer Assisted Sperm Analysis (CASA) Plugin for analyzing sperm motion in microfluidic environments using Image-J

M. Elsayed, T. M. Elsherry, M. Abdelgawad

Abstract:

We modified a previously reported computer-assisted sperm analysis (CASA) plugin for Image-J to enable analyzing motion of sperm cells in microfluidic environments. Microfluidics is increasingly being used in sperm-related applications such as sperm selection, IVF, and sperm motion behavior. Current CASA systems are not capable of analyzing motion of sperm cells in microfluidic devices where both sperm cells and the liquid itself are constantly moving, contrary to the conventional situation of sperm cells moving in a stationary liquid. We resolved this deficiency in the modified plugin reported here and built an image processing pipeline to enhance object detection, which increased CASA accuracy considerably. More importantly, particle tracking was improved and modified to accommodate sperm cells going out of focus for short periods during swimming on the same track. This last feature is particularly important in microfluidics where height of the microchannel is larger than that of CASA custom chambers to avoid channel blockage; this increased height causes sperm cells to frequently come in and out of focus. New parameters were introduced to allow studying new aspects of sperm motion behavior such as rheotaxis and wall tracking. The new plugin was able to detect and analyze motion of human, bull, and chicken sperm. A preliminary study using this tool agreed well with previously reported studies on rheotaxis and wall tracking behavior of sperm.

Keywords:

Computer-assisted sperm analysis Open source Image processing Sperm analysis Particle tracking Microfluidics

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