Cell Density Estimation from a Still Image for In-Situ Microscopy

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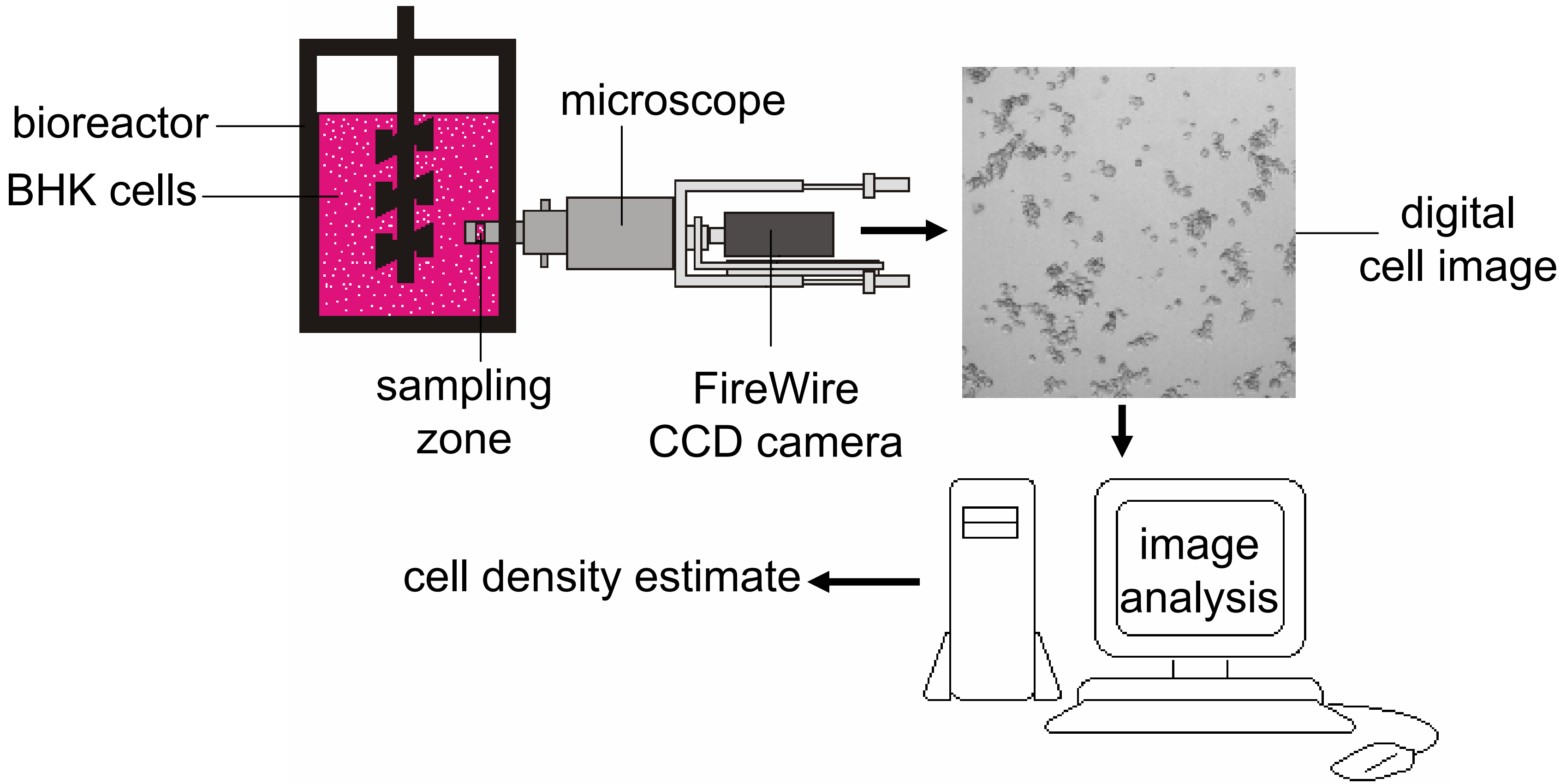
In-Situ Microscopy

On-line automatic cell density estimation (cell count) with no risk of culture contamination

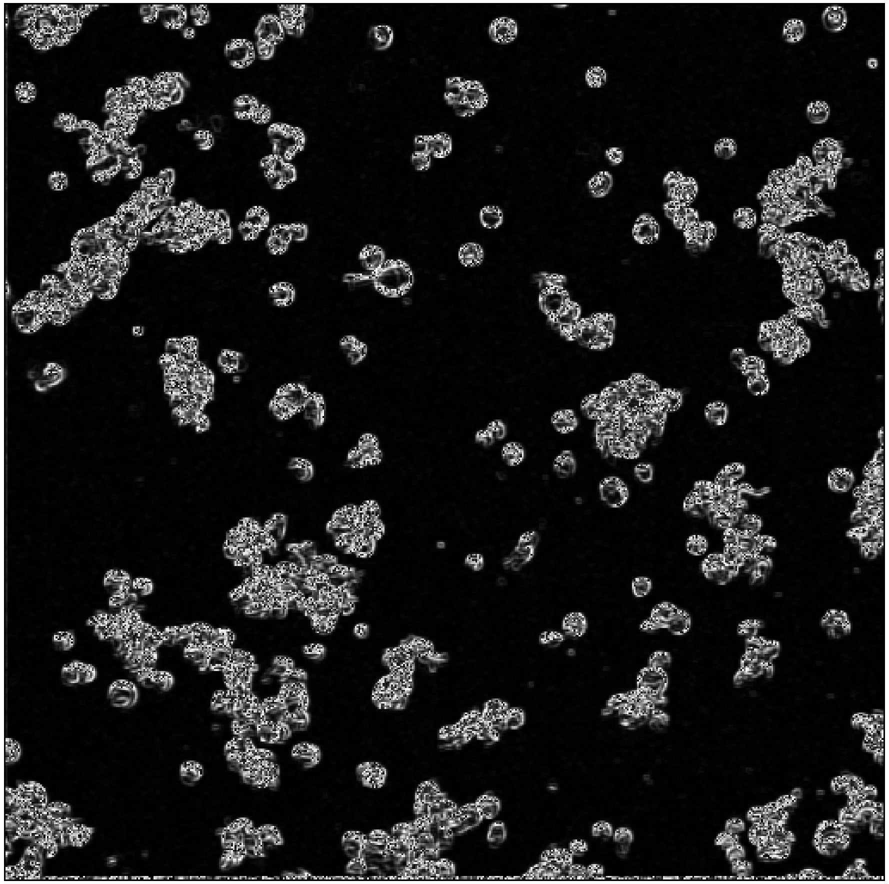


Cell density estimation algorithm

1) Capture a digital cell image *I*

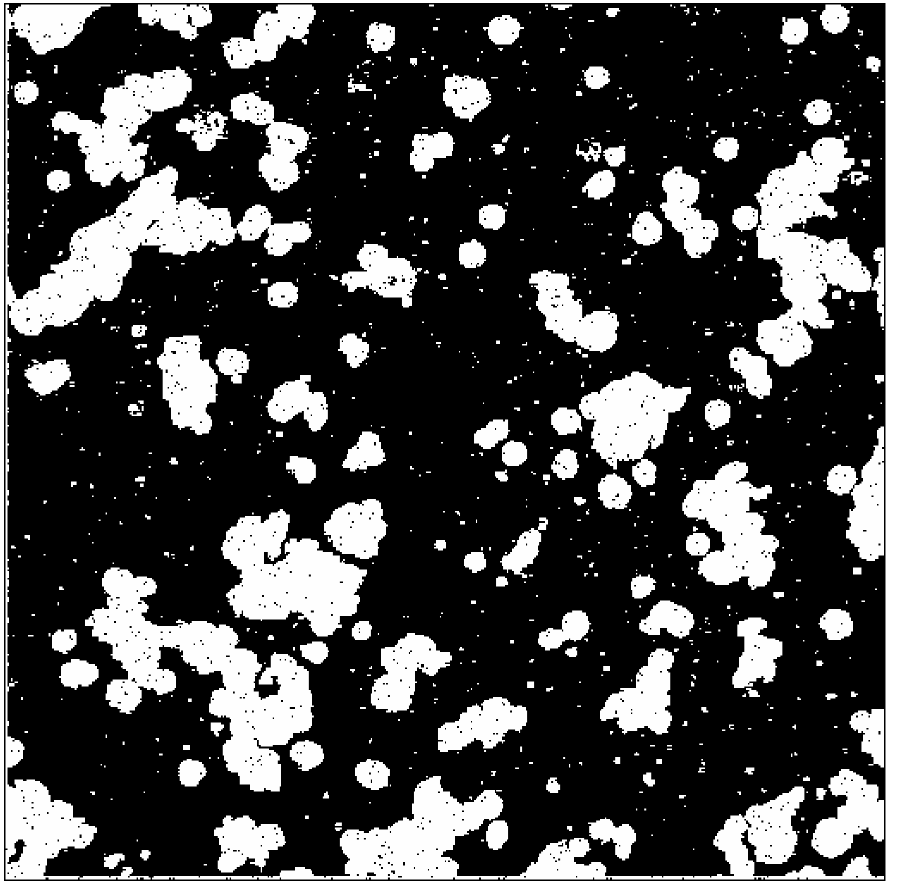
Cell density estimation algorithm

2) Compute the local variance at each pixel position using a 3x3 window



Cell density estimation algorithm

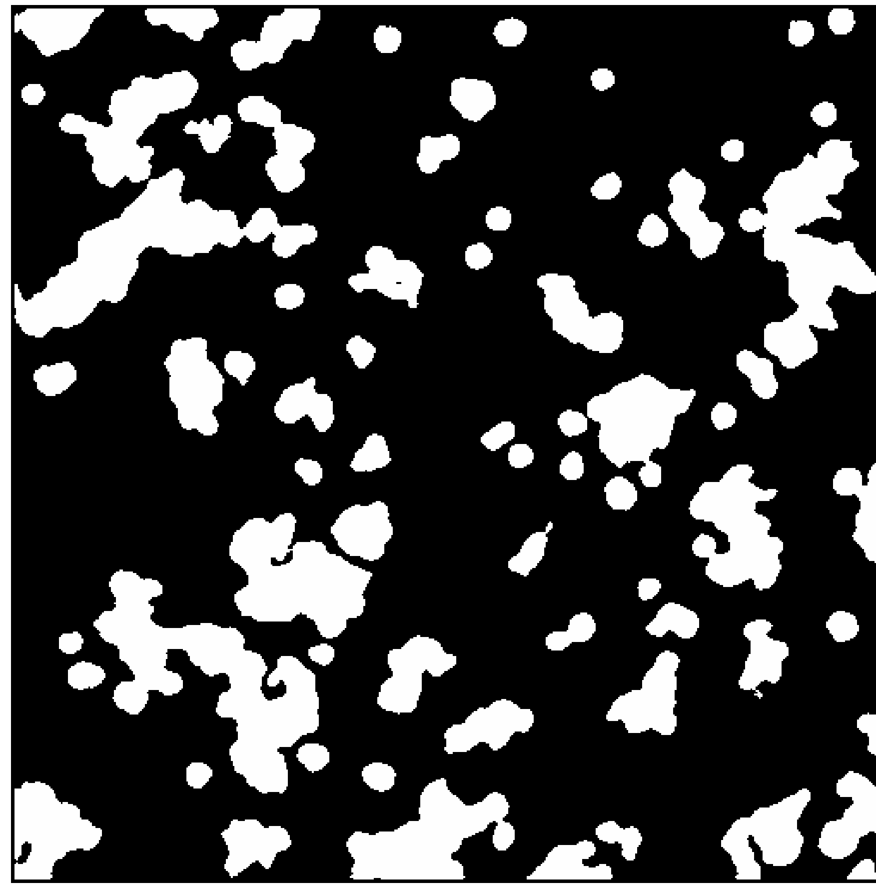
3) Classify the pixels into pixels of the cell clusters and pixels of the background by applying a Maximum-Likelihood thresholding algorithm



Cell density estimation algorithm

4) Eliminate isolated white pixels by applying a 5x5 median filter

5) Eliminate regions whose image area is less than 0.05% of the total image area



Cell density estimation algorithm

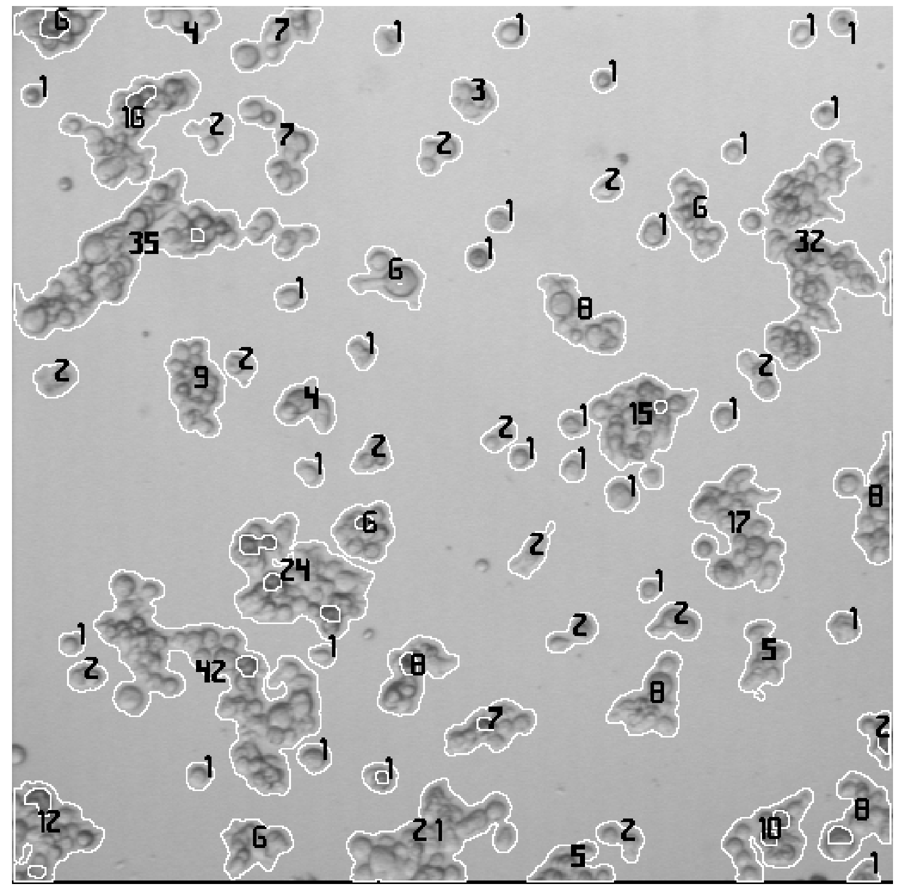
6) Estimate the average cell radius R_k of each cluster *k* by maximizing the variance of the circular Hough transform of the edges inside the cluster

$$\sigma(H(R_k))^2 \geq \sigma(H(r))^2 \;\; \forall \;\; r = 1, 2, ...$$

Cell density estimation algorithm

7) Compute the number of cells D_k of each cluster k as the quotient between the area of the cluster A_k and the area of a circle of radius R_k

$$D_k = \frac{A_k}{\pi {R_k}^2} * 0.765$$

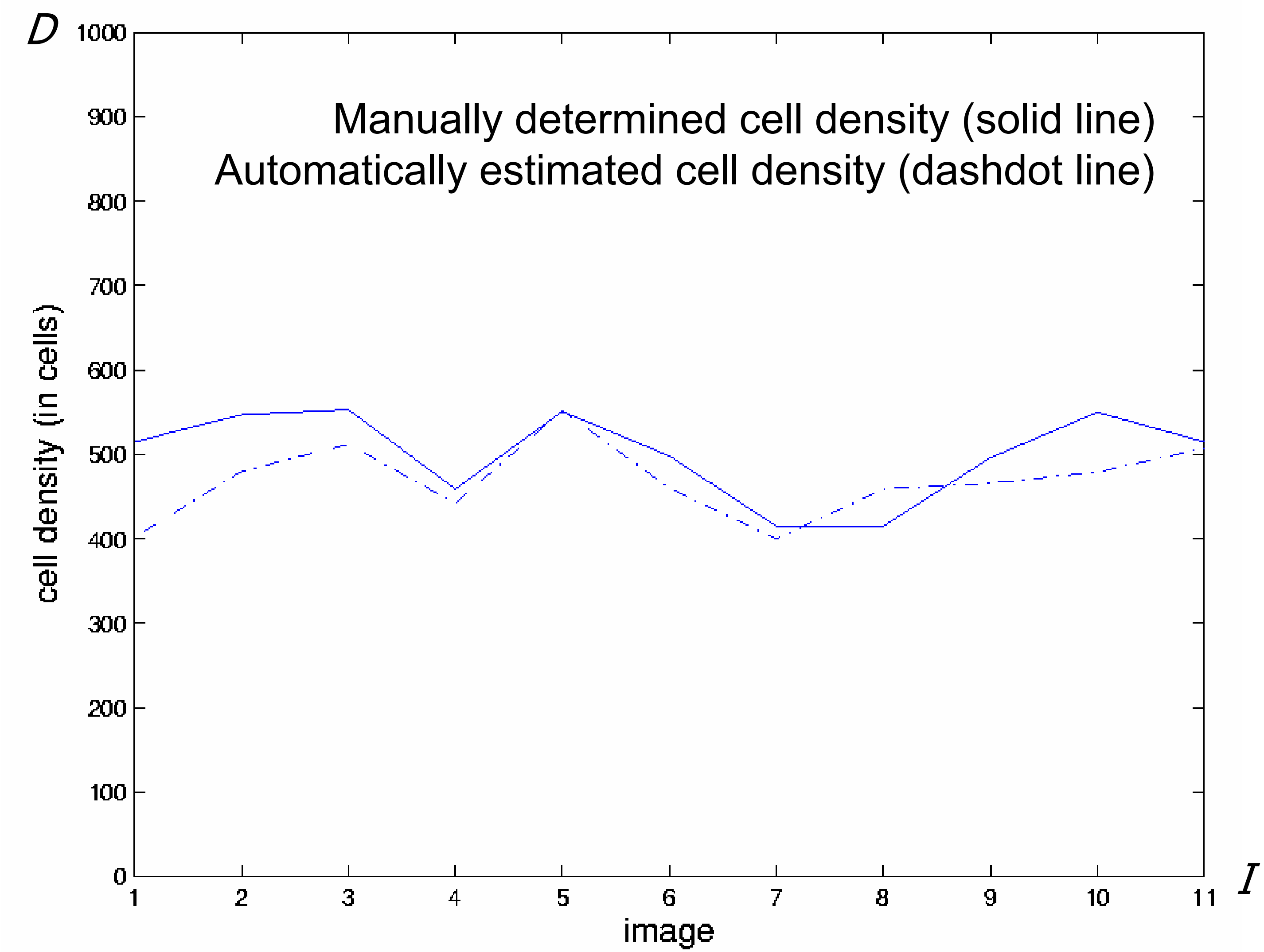


Cell density estimation algorithm

8) Compute the total cell density D of the image I

$$D = \sum_{k=1}^{K} D_k$$

Experimental results



Experimental results

- Processing time: **15.88s**
- Absolute error: **6.27%**
- Cell density estimates similar to those obtained with off-line techniques up to cell densities of **5x10^6 cells/mL**

Conclusions

- Reliable cell density estimation even though cells build clusters in the scene
- Cell density estimates similar to those obtained with off-line techniques up to cell densities of 5x10^6 cells/mL
- For higher cell concentrations the 3D shape of the clusters must also be estimated and taking into account for cell density estimation