Classifying acanthocytes using image processing and ML techniques: A comparative study

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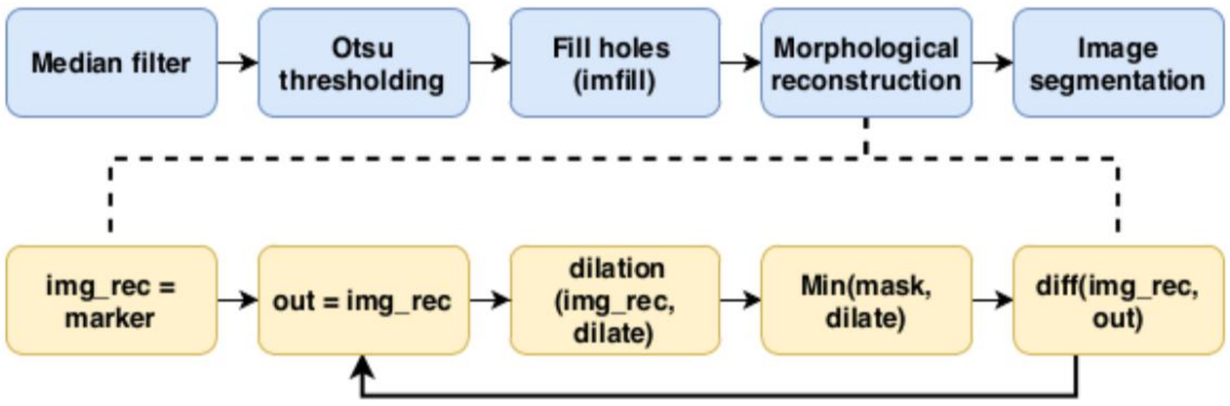
Introduction

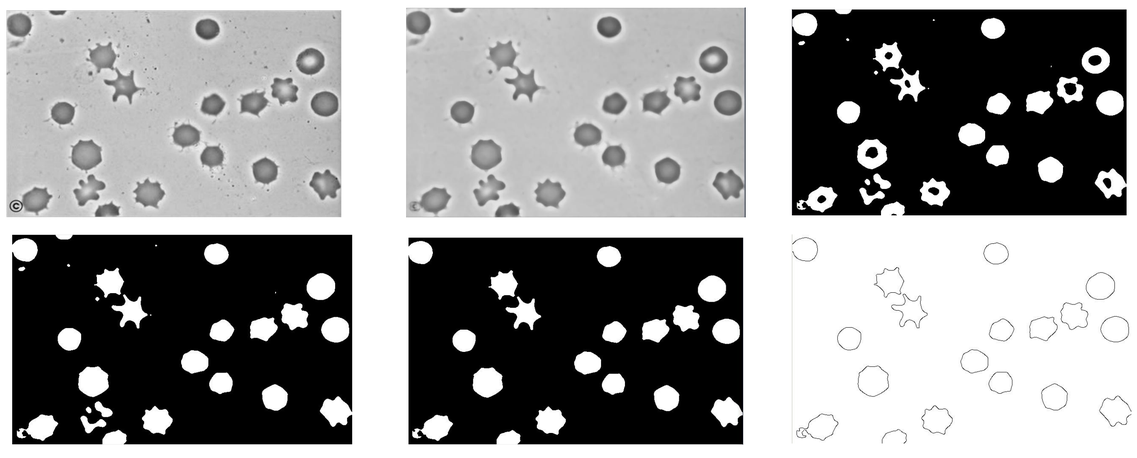
Objective: develop a reliable detection and classification procedure for acanthocytes, using a reduced set of features.
Segment blood cells: Image processing
Classify: ML models
Output: classification of each blood cell into normal or acanthocytes.

Normal cells | Acanthocytes

Proposed approach



1. Normalize an input image (gray scale)
2. Apply 9x9 median filter to smooth noise
3. Convert image to binary using the Otsu thresholding method
4. Some holes in the middle of the cells and medium-sized noise. To solve that it was filling operation (imfill) that applies a guided flooding operation to close holes inside blobs
5. Morphological reconstruction (elliptic shaped 9x9 kernel) is applied to remove the medium-sized noise produced during the binarization
6. Canny edge detector is applied to extract region contours



Features:

→ Histogram from the chain code
- characterizes the shape of a contour
- Not characterizes rotation and scale invariant
- We compute an histogram with the relative weight for each direction of the chain code

→ circularity
→ roundness
→ aspect-ratio and solidity

Results

Algorithm	Precision	F-Measure	MCC
k-NN(1)	0.710	0.704	0.415
k-NN(3)	0.709	0.684	0.400
k-NN(5)	0.748	0.723	0.476
Naive Bayes	0.680	0.652	0.342
Logistic Regression	0.867	0.864	0.731
Decision Tree	0.879	0.879	0.757
Random Forest	**0.910**	**0.909**	**0.819**
Support Vector Machine	0.711	0.630	0.363
Neural Network	0.886	0.886	0.773

Conclusions

- Top 3 models are: Random Forest, Neural network (multi-layer perception) and Decision tree
- Decision tree model only uses the following features: solidity, circularity. aspect ratio, h5 and h3 (values from the chain code histogram)
- The model selects as the most relevant features: solidity and circularity
- The aspect ratio, h5 and h3 are used only for the corner cases

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