

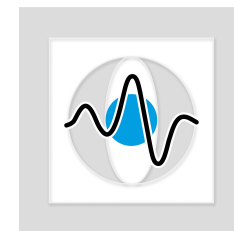
Medical Image Processing for Interventional Applications

Random Walker – Application Example

Online Course – Unit 43

Andreas Maier, Stefan Steidl, Frank Schebesch

Pattern Recognition Lab (CS 5)



Topics

Implementation

Example

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MATLAB Implementation

- **Graph Analysis Toolbox** available for MATLAB to:
 - easily build weighted image graphs,
 - solve the combinatorial Dirichlet problem.
- With **specialty code** using the toolbox above, the random walker segmentation can be performed:
 - recommended for research purposes,
 - sufficient for 512×512 images,
 - more industrial use requires C++ implementation of conjugate gradients or multigrid code.

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Example: Axial CT Slice

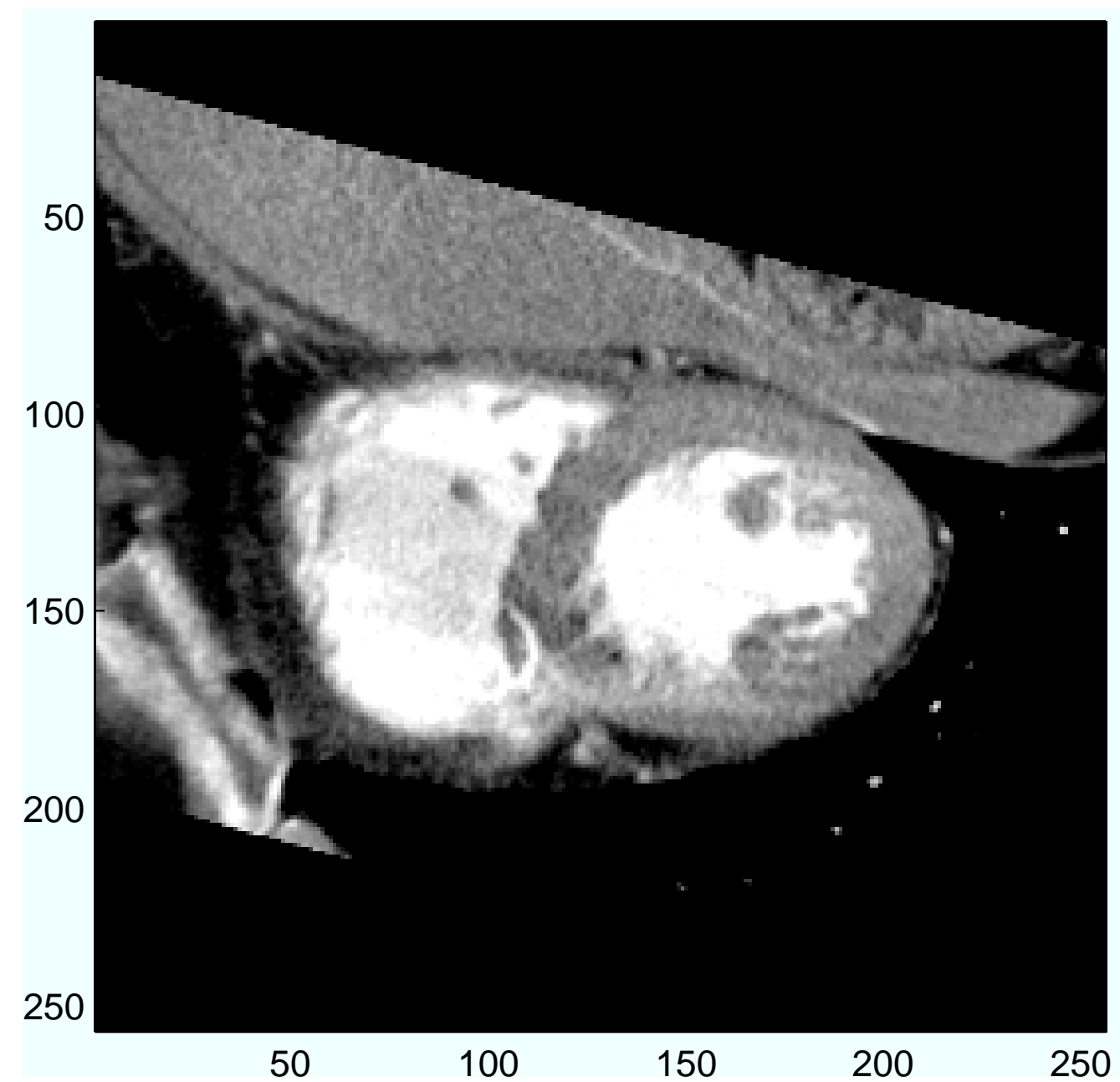


Figure 1: Original image

Example: Axial CT Slice

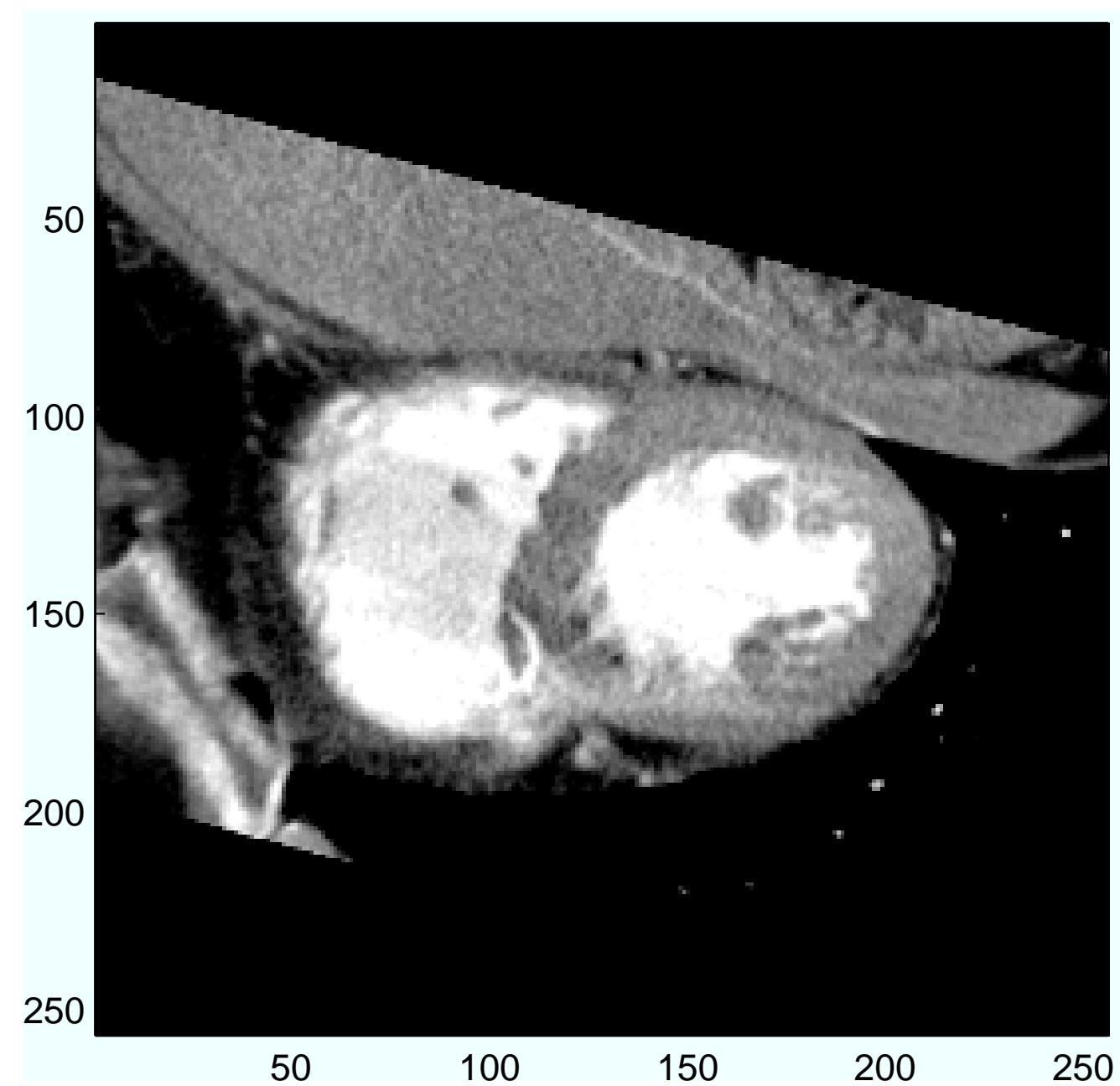


Figure 1: Original image

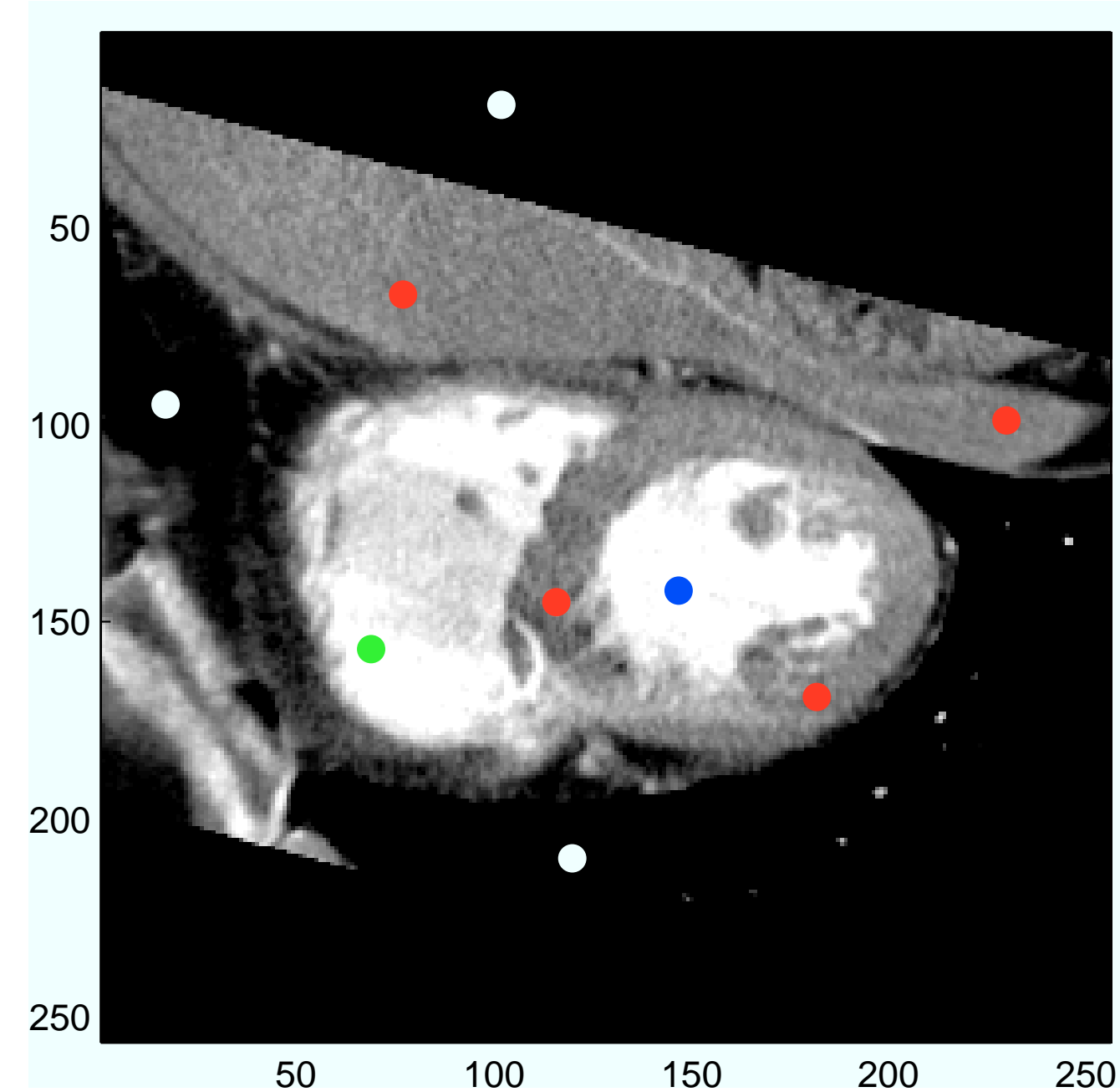


Figure 2: Original image with seed points

Example: Axial CT Slice

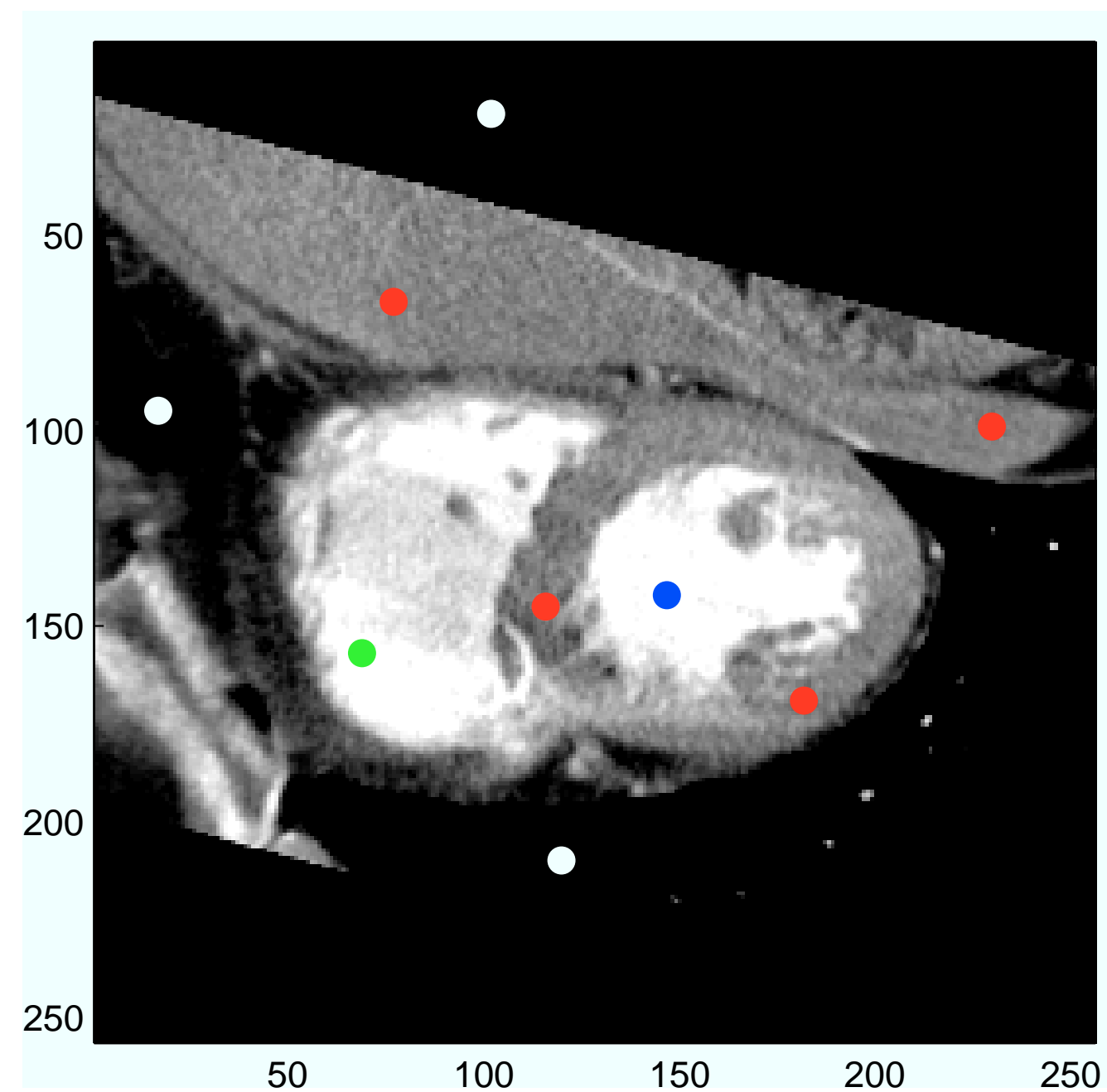


Figure 2: Original image with seed points

Example: Axial CT Slice

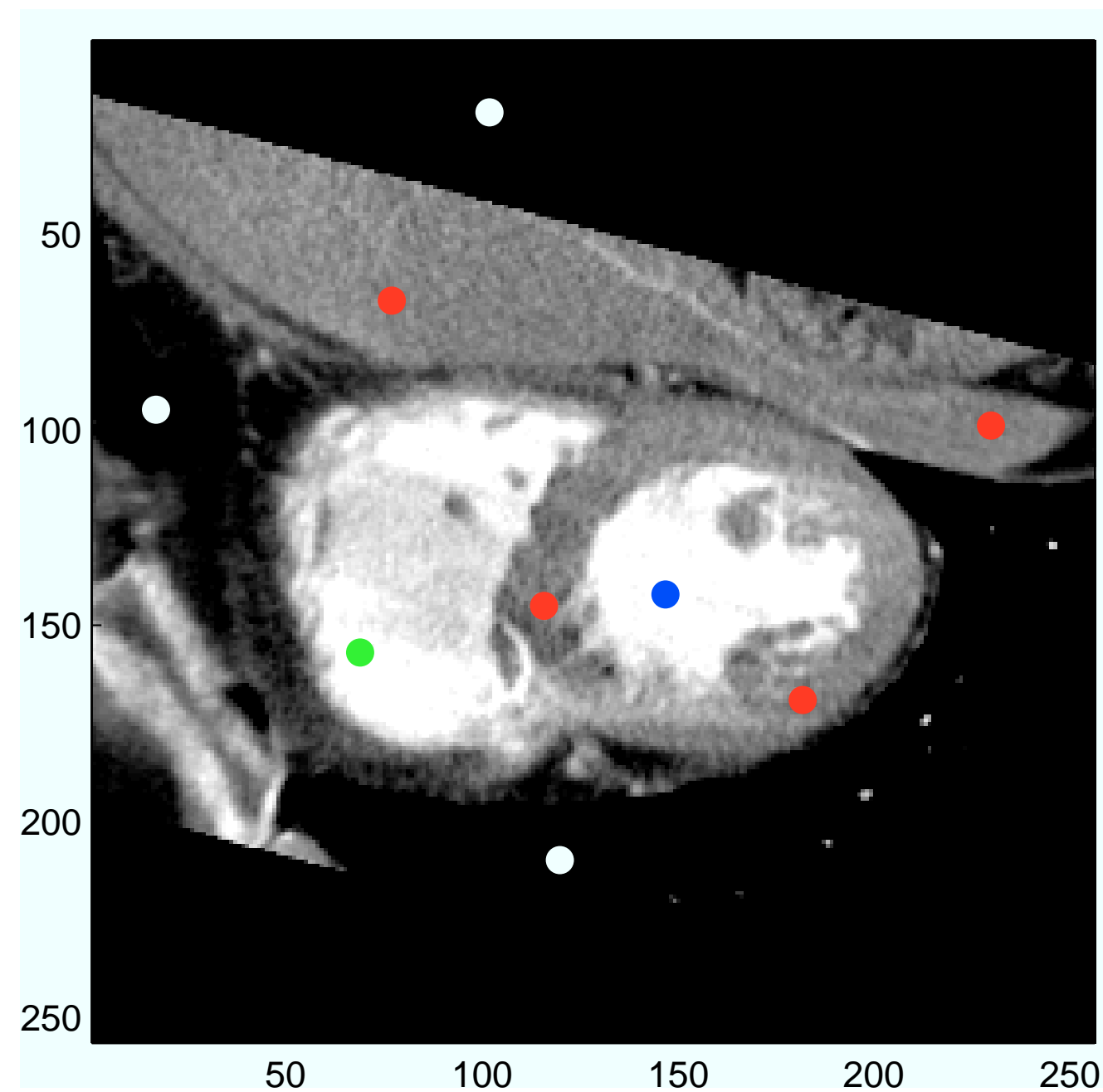


Figure 2: Original image with seed points

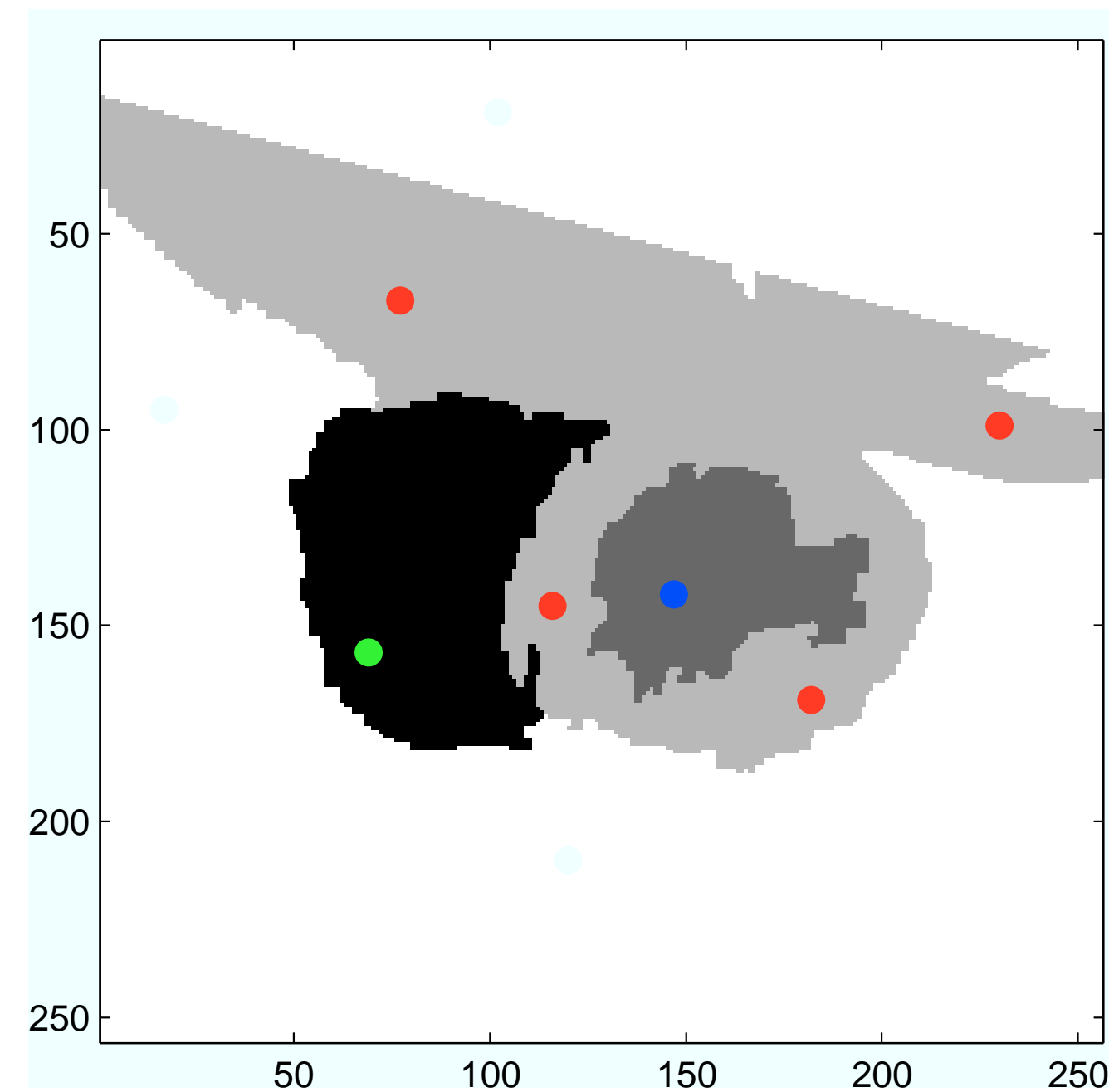


Figure 3: Output mask

Example: Axial CT Slice

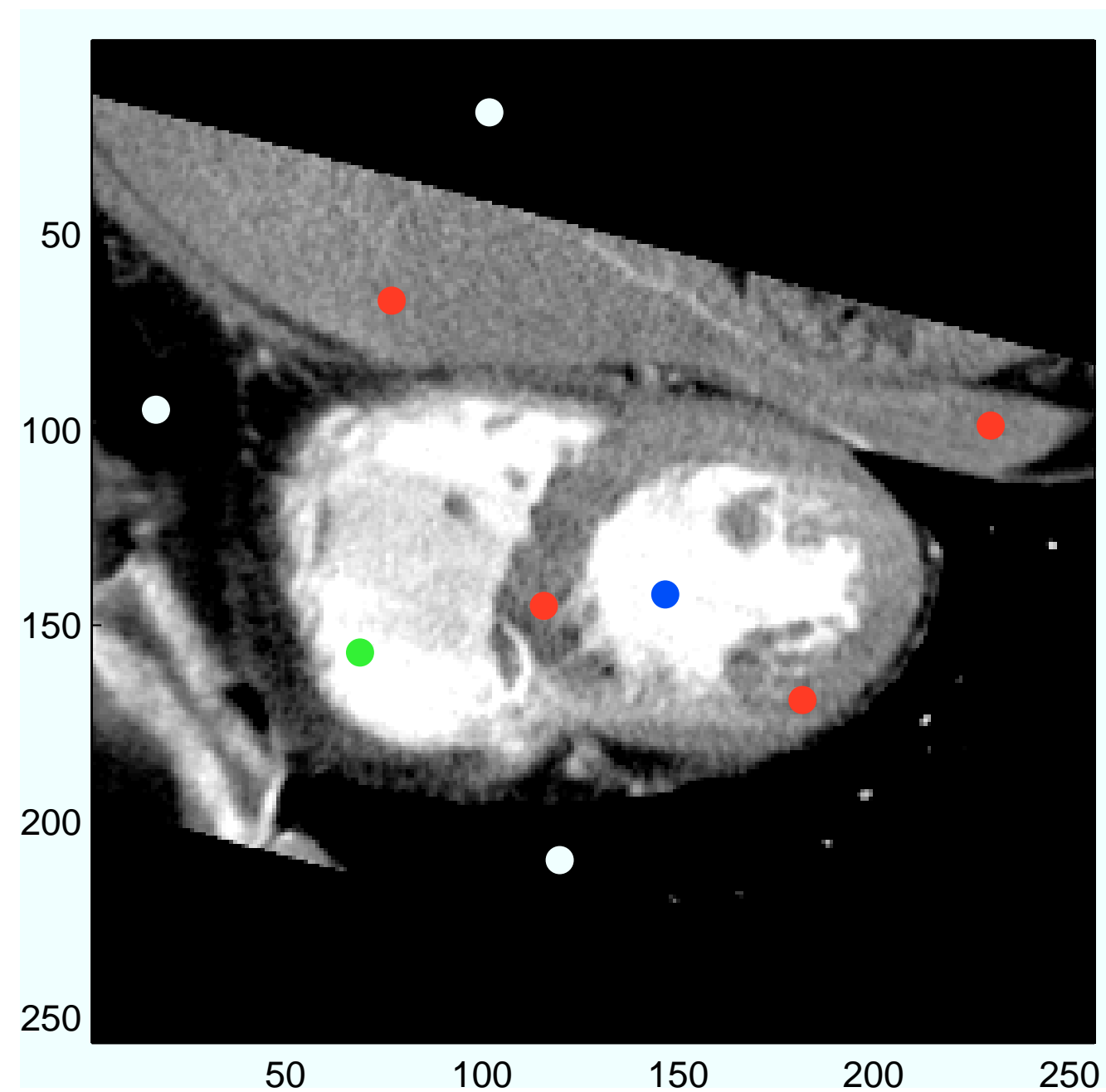


Figure 2: Original image with seed points

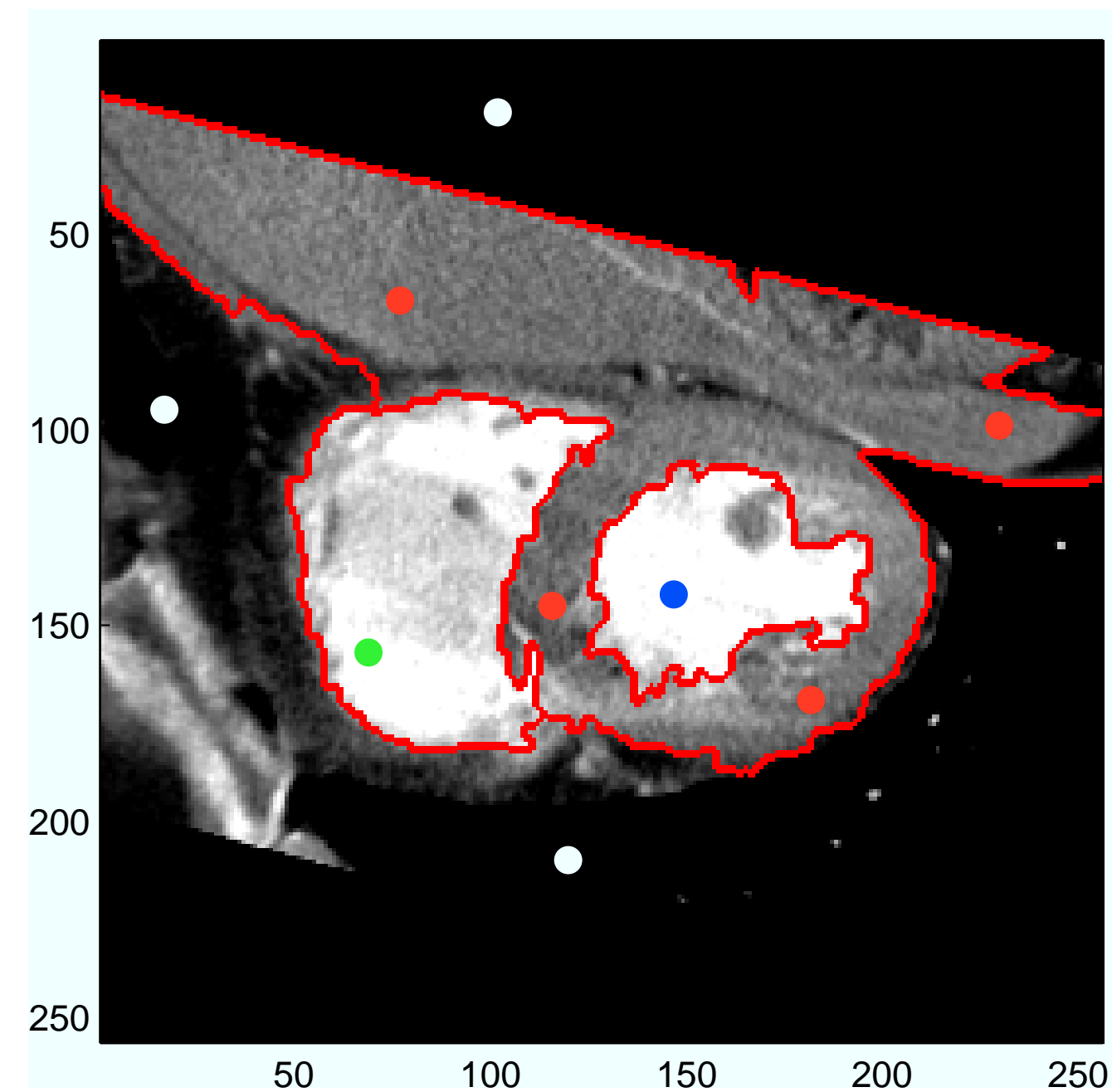


Figure 4: Outlined mask

Example: Axial CT Slice

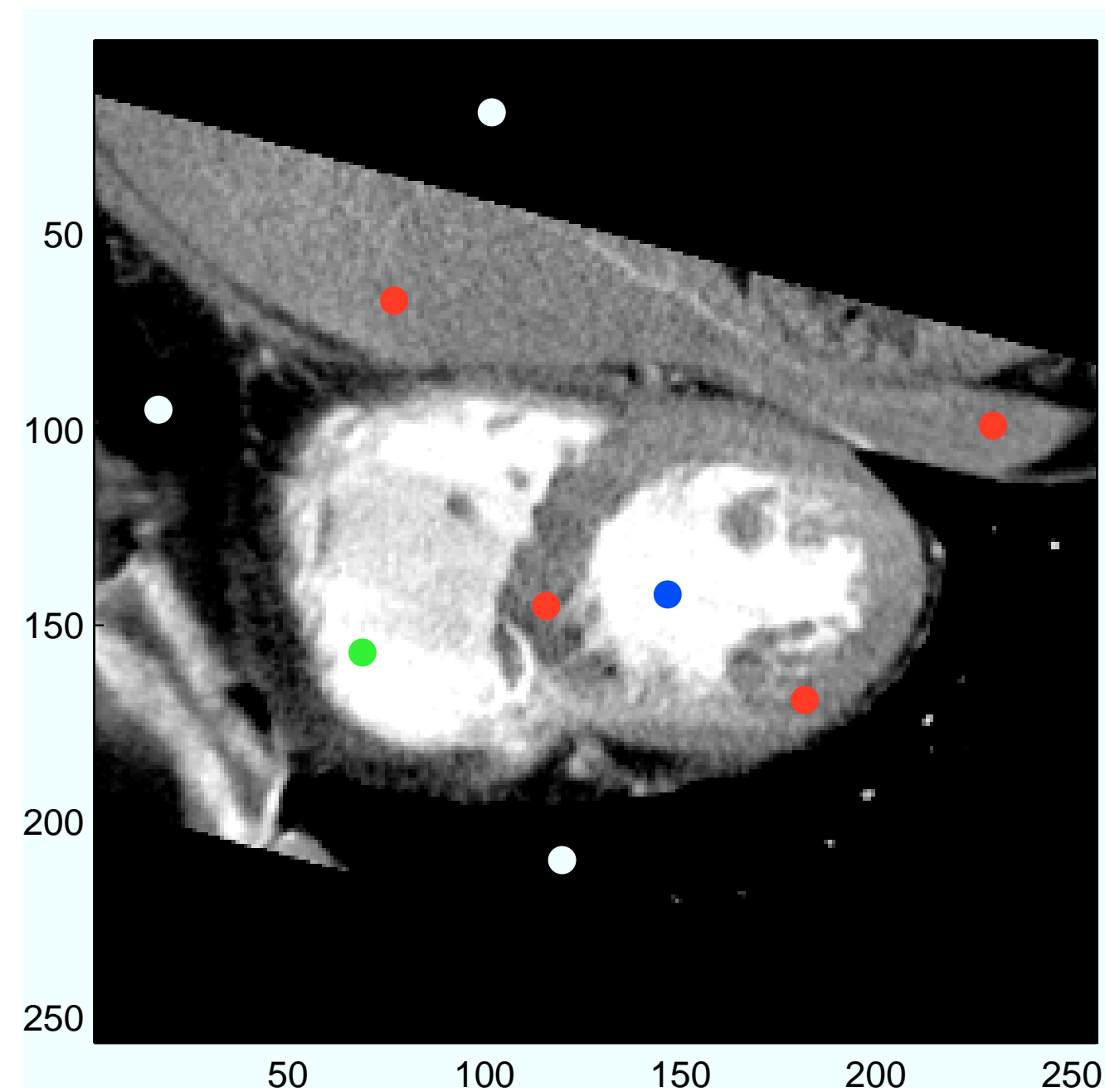


Figure 2: Original image with seed points

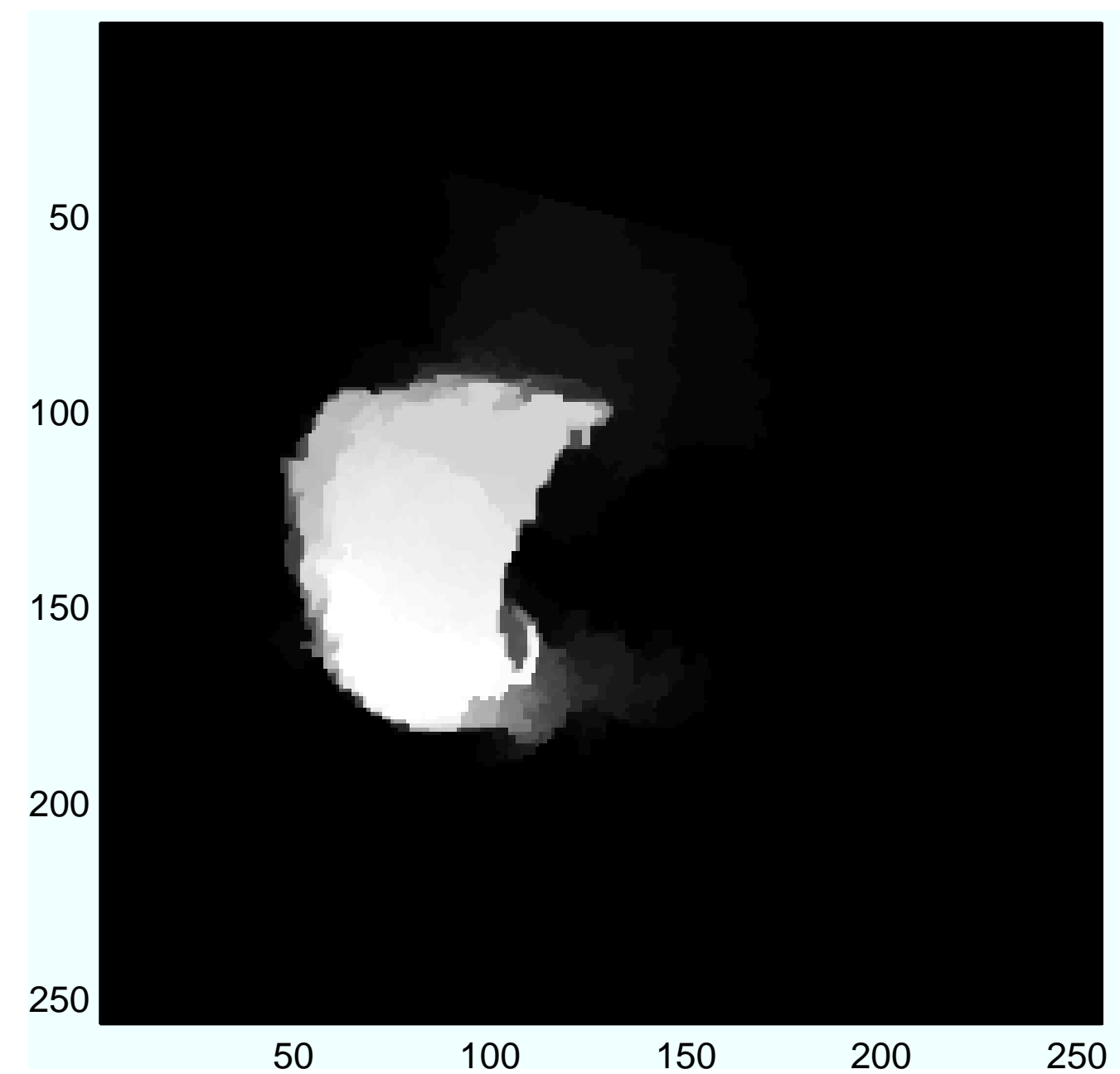


Figure 5: Probabilities for reaching seed 1

Example: Axial CT Slice

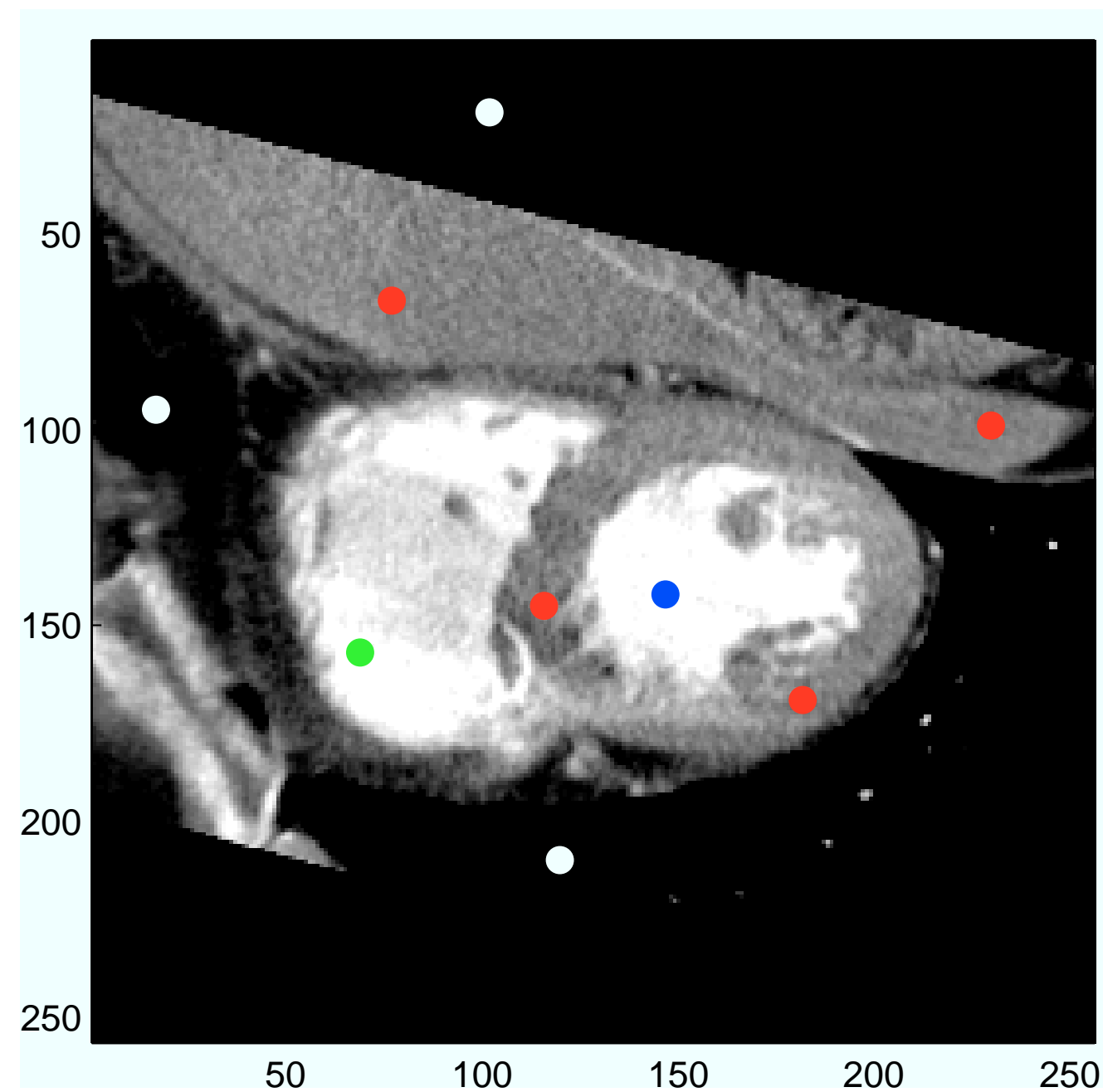


Figure 2: Original image with seed points

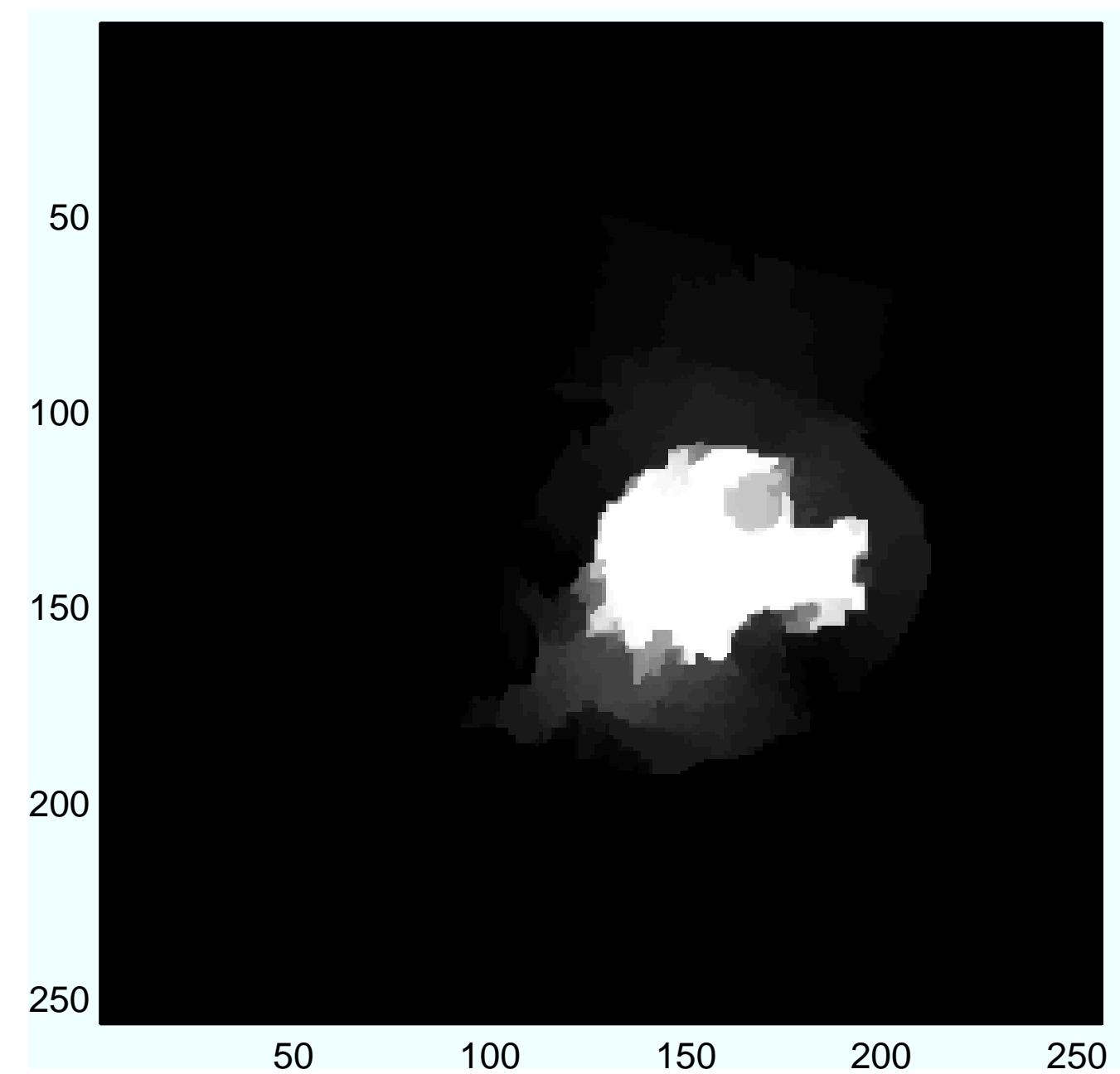


Figure 6: Probabilities for reaching seed 2

Example: Axial CT Slice

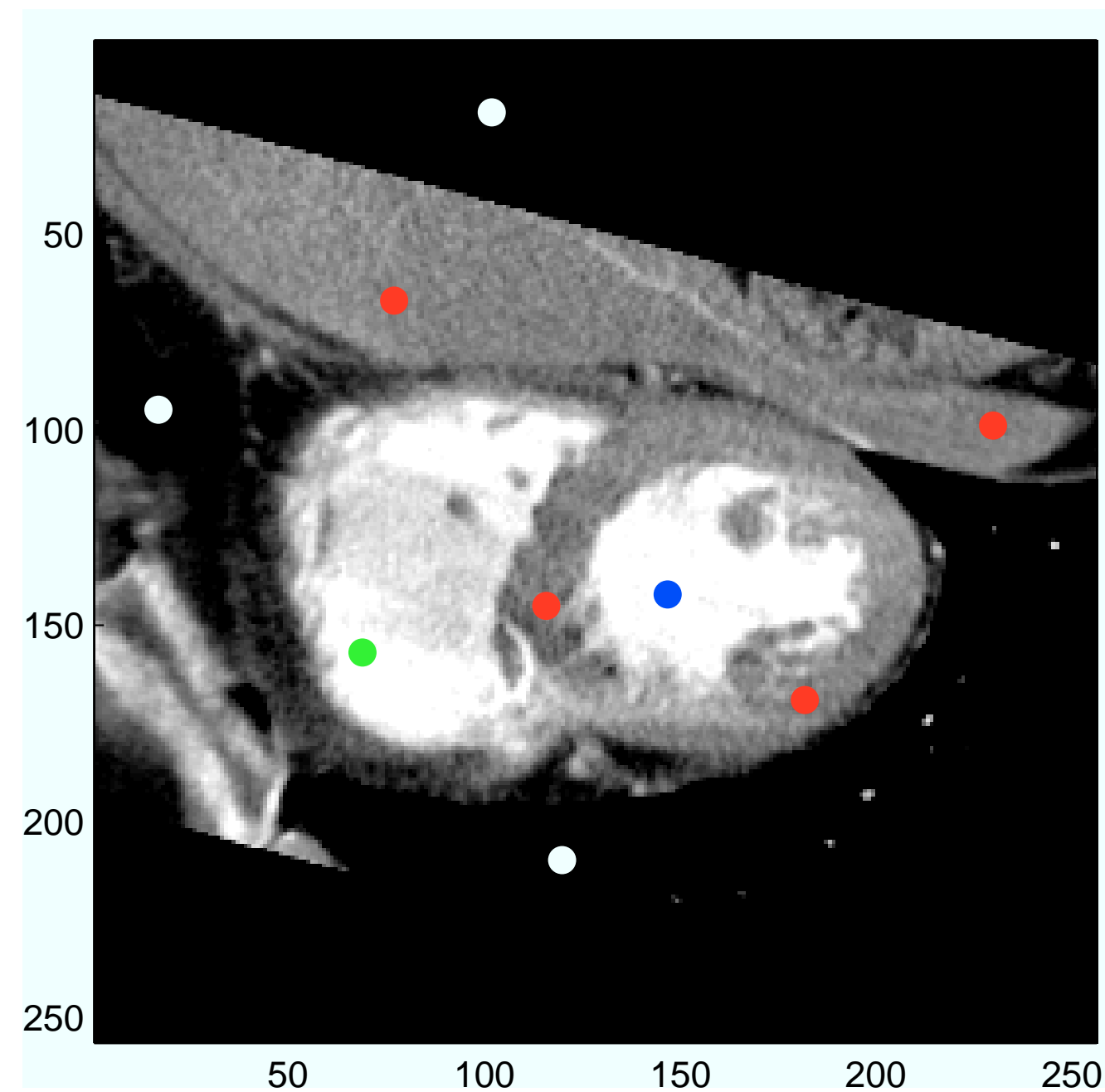


Figure 2: Original image with seed points

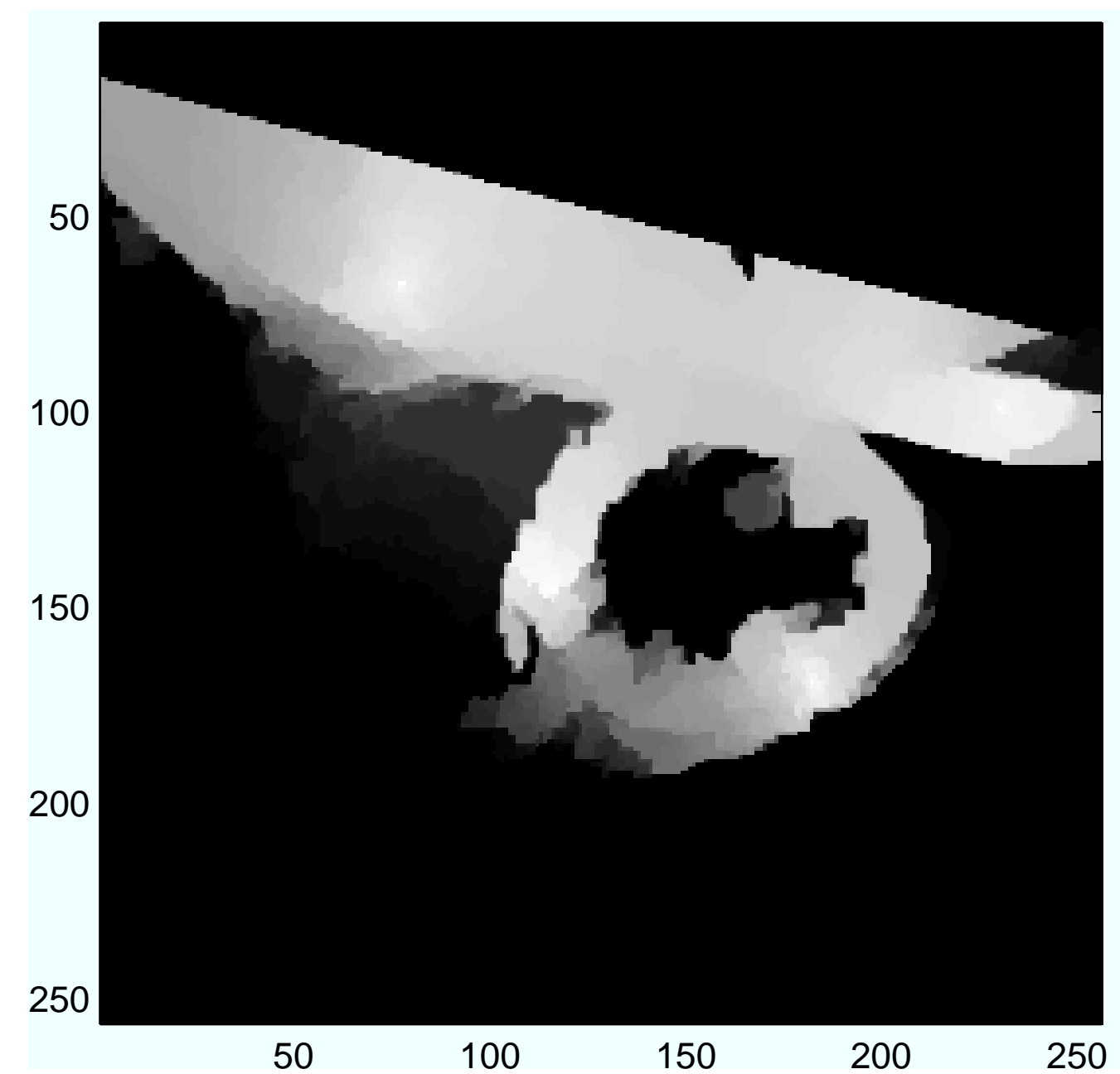


Figure 7: Probabilities for reaching seed 3

Example: Axial CT Slice

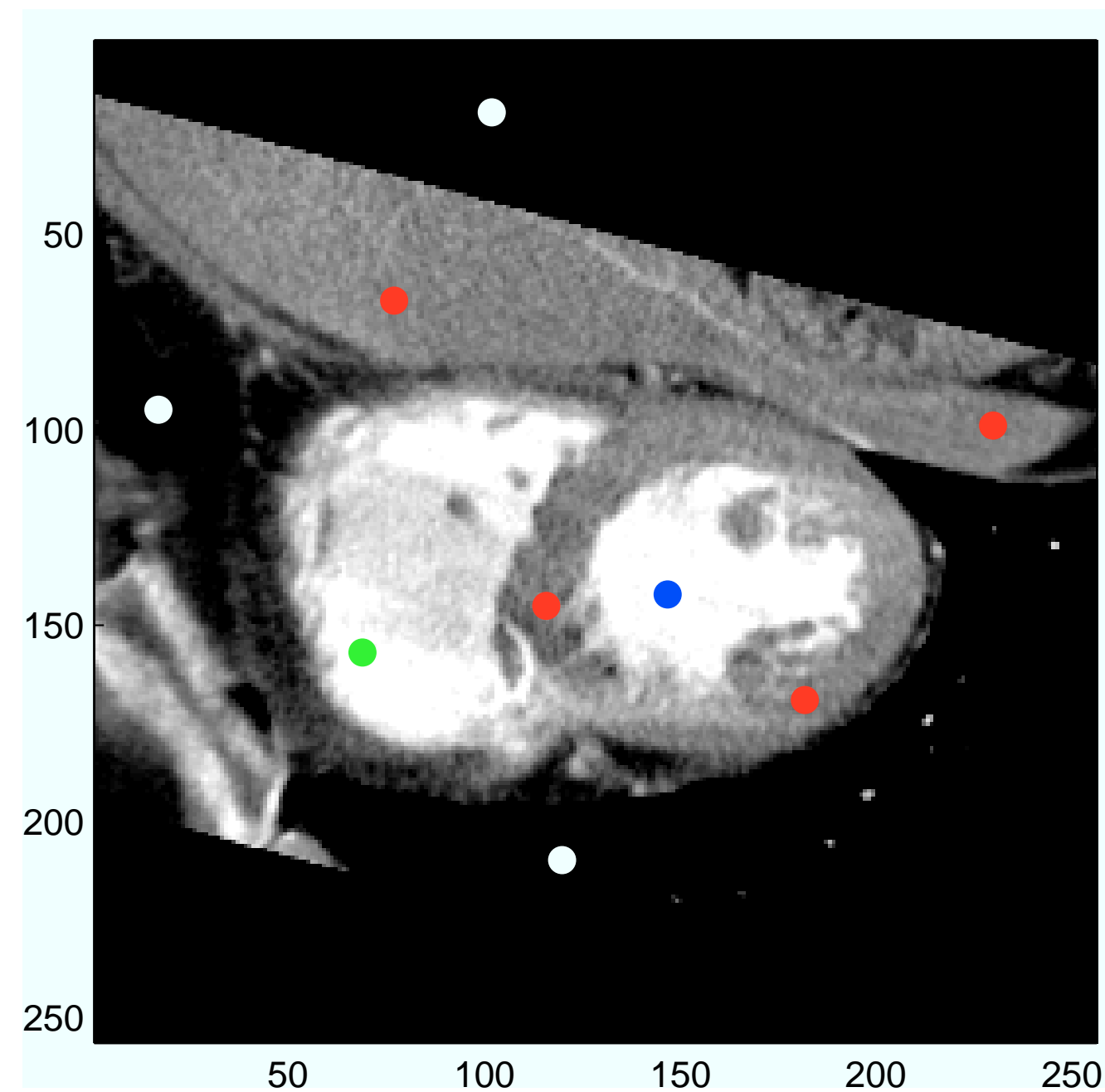


Figure 2: Original image with seed points

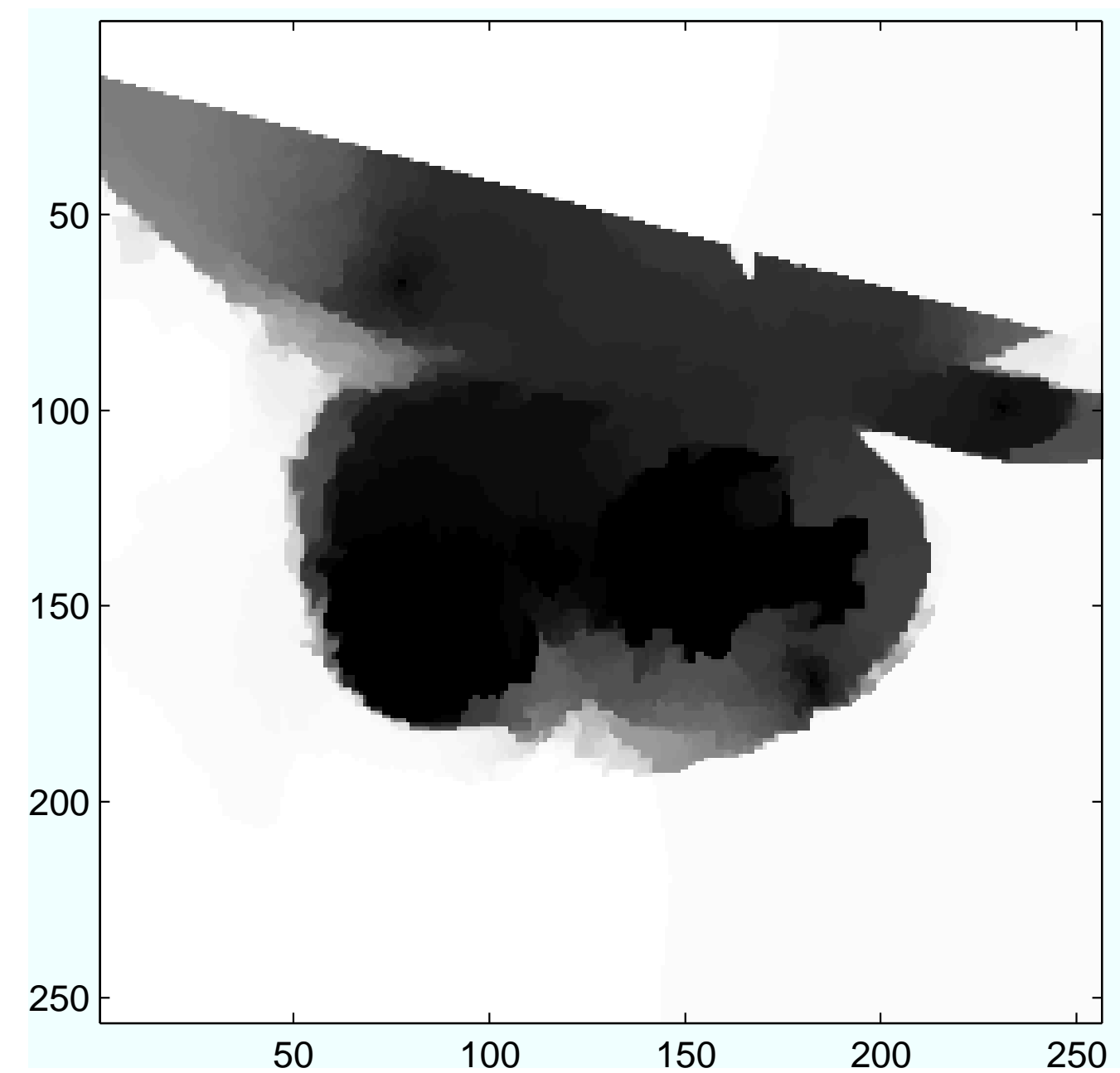


Figure 8: Probabilities for reaching seed 4

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- The random walker algorithm has a straightforward implementation with only one free parameter.
- It is computed by solving a sparse, symmetric, positive-definite system of equations.
- This method has a lot of useful properties:
 - segments are guaranteed to be connected,
 - noise robustness,
 - no discretization errors,
 - efficient performance.
- Interactive editing is a possible extension, where a previous solution is used as an initial solution for an iterative matrix solver.

Further Readings

These slides are based on the following publication:

L. Grady. “Random Walks for Image Segmentation”. In: *IEEE Transactions on Pattern Analysis and Machine Intelligence* 28.11 (Nov. 2006), pp. 1768–1783. DOI: 10.1109/TPAMI.2006.233

His implementations in Matlab can be downloaded here:

- Graph Analysis Toolbox
- Random Walker