An Optimal Graph-Cut Method for Atrial Wall Segmentation from Delayed Contrast MRI

Gopal B Veni, Zhisong Fu, Suyash Awate and Ross T. Whitaker
Scientific Computing and Imaging Institute, University of Utah, Salt Lake City, UT
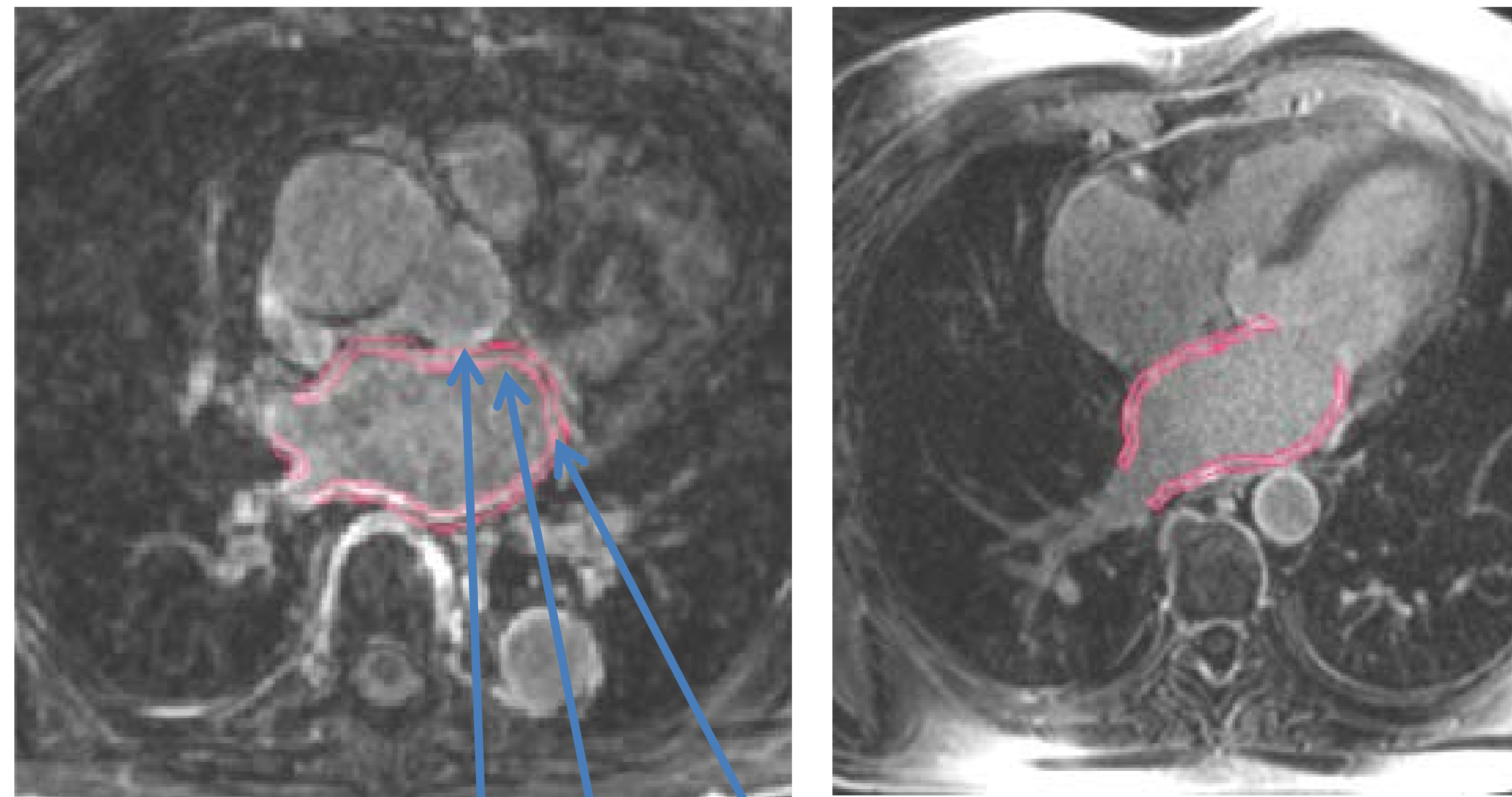
2012

Goal

- Automatic segmentation of left atrium from Delayed Enhancement (DE) MRI using graph cuts on a proper ordered graph.

Motivation

- Atrial fibrillation (A-fib): Most common cardiac arrhythmia.
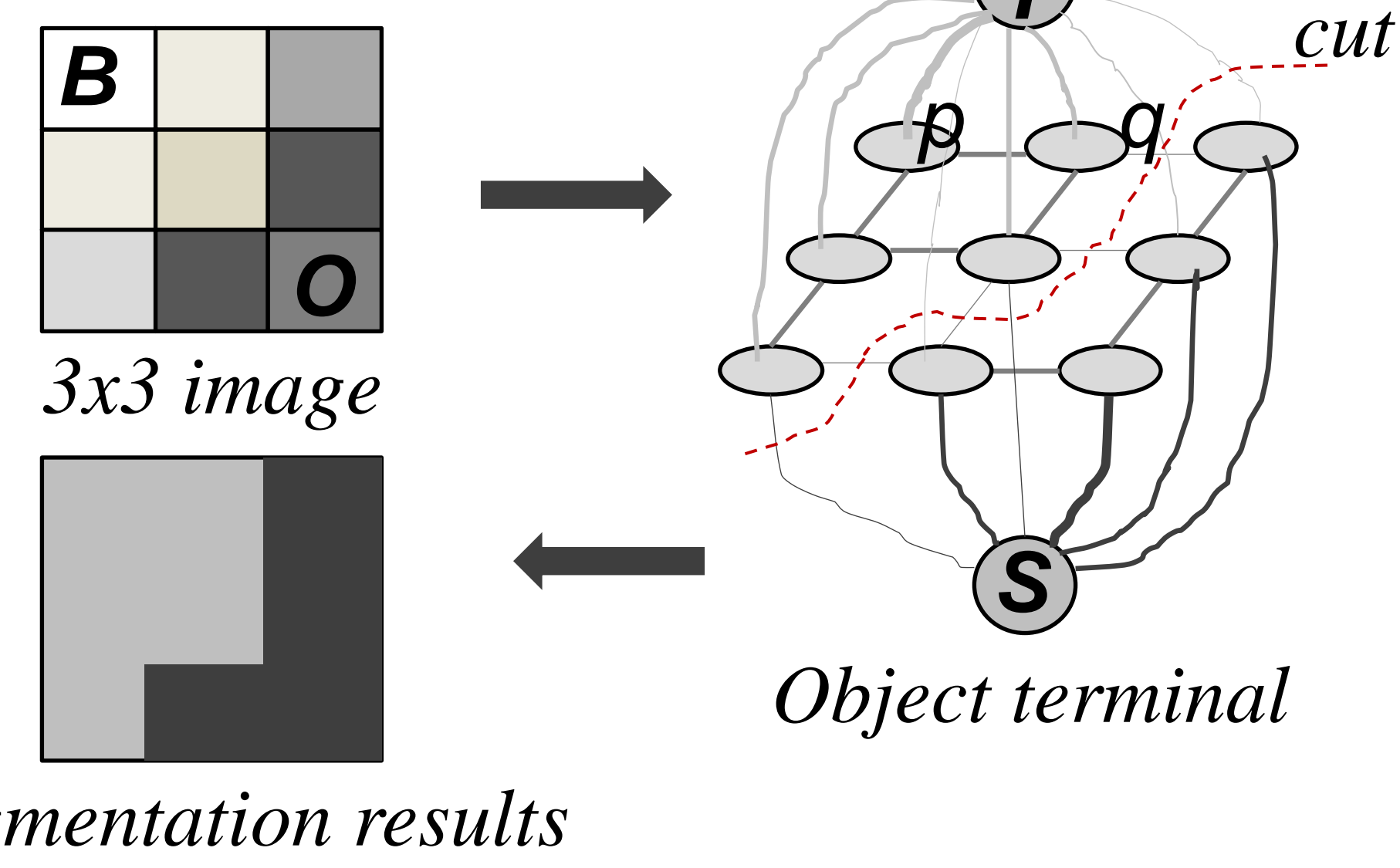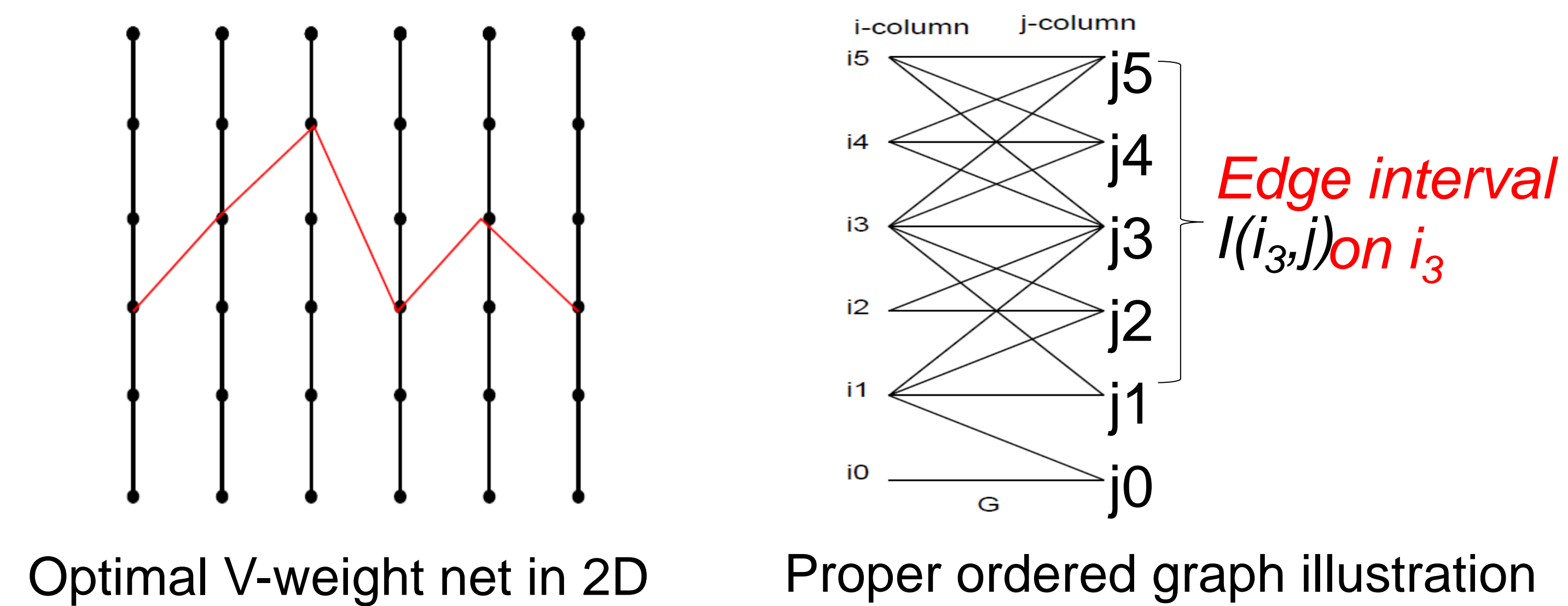
Challenges

Atrial wall
Endocardium
Epicardium

Analogy between image segmentation and graph cuts

- **Image segmentation:** Categorization of image pixels into different groups.
- **Graph-cuts:**
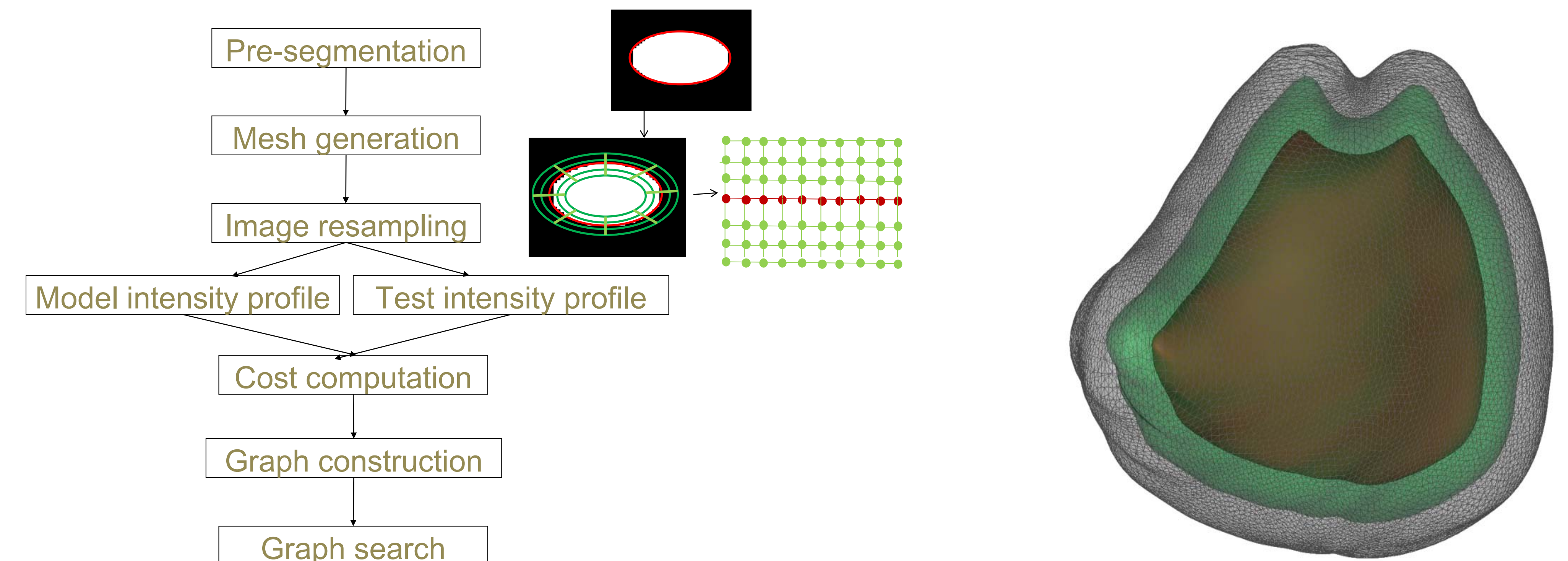 Partition of graph nodes into two subsets.

3x3 image

Segmentation results

Background terminal

cut

Object terminal

Optimal net surface problem on proper ordered graph

Optimal V-weight net in 2D

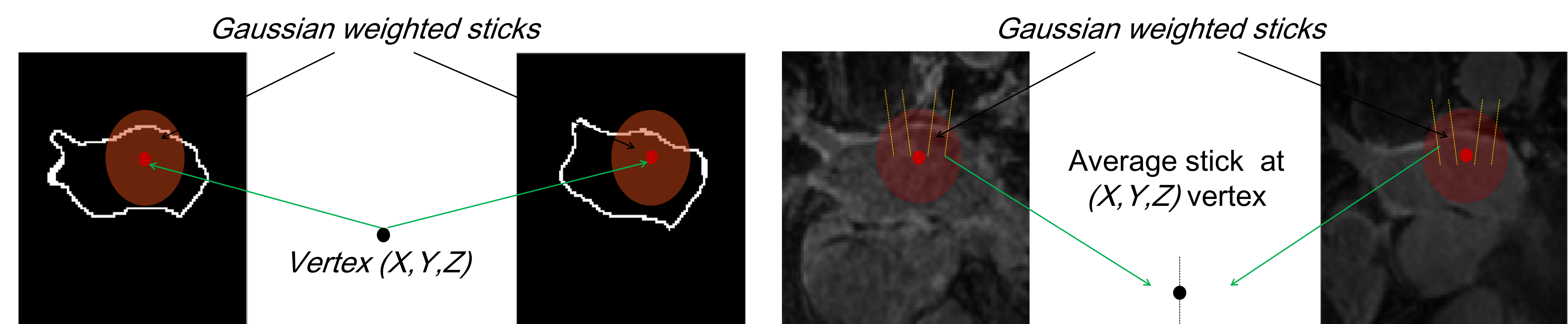Proper ordered graph illustration

Edge interval $I(i_3,j)$ on i_3

Optimal multiple surface segmentation

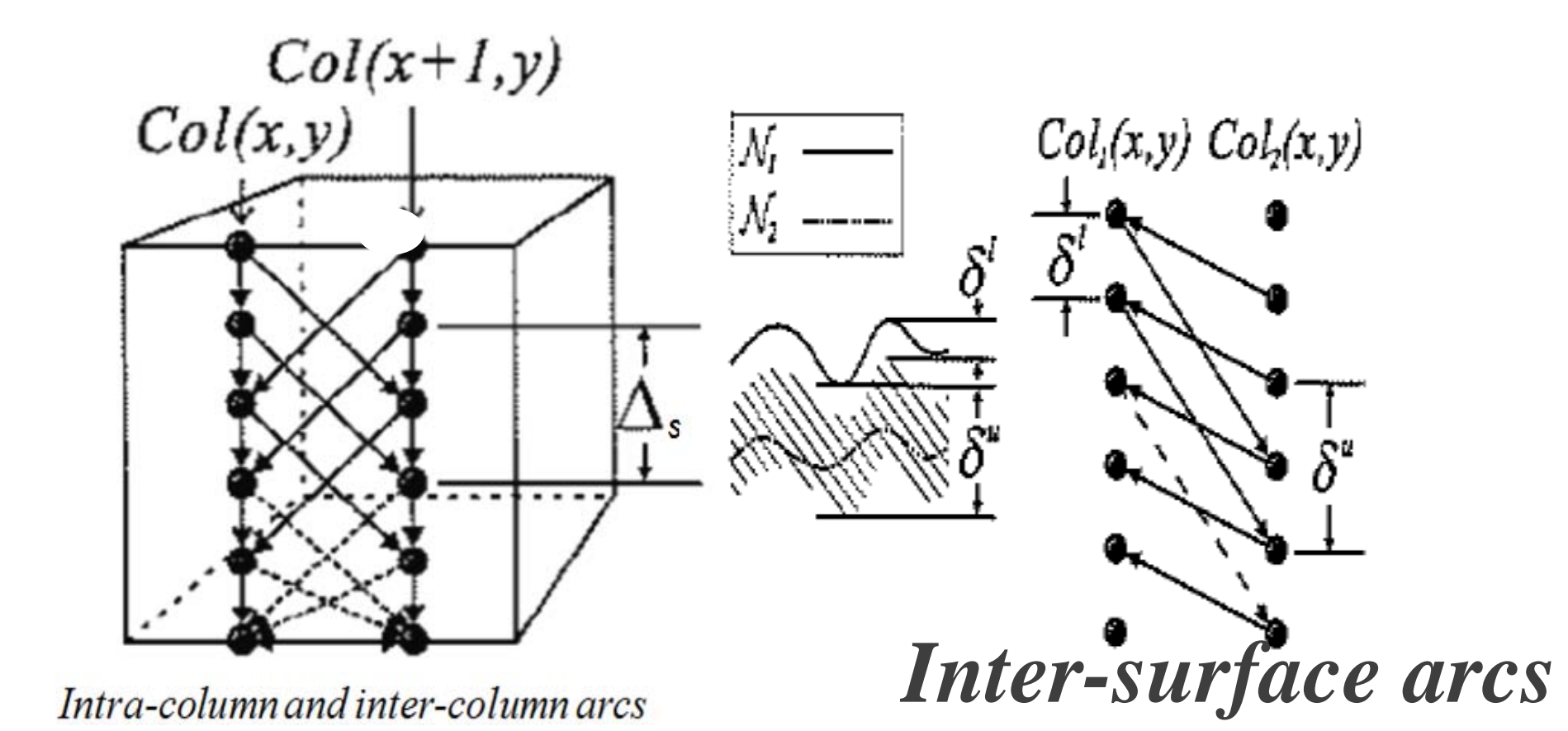- Due to high variability of LA shapes, a learning strategy is used to construct templates.
- Nested mesh layer generation using dynamic particle system.

Pre-segmentation
Mesh generation
Image resampling
Model intensity profile | Test intensity profile
Cost computation
Graph construction
Graph search

Model stick computation

Gaussian weighted sticks

Gaussian weighted sticks

Vertex (X,Y,Z)

Average stick at
(X,Y,Z) vertex

Arcs in the graph

$Col(x+1,y)$
$Col(x,y)$
$Col_i(x,y)$ $Col_j(x,y)$

Intra-column and inter-column arcs

Inter-surface arcs

Results