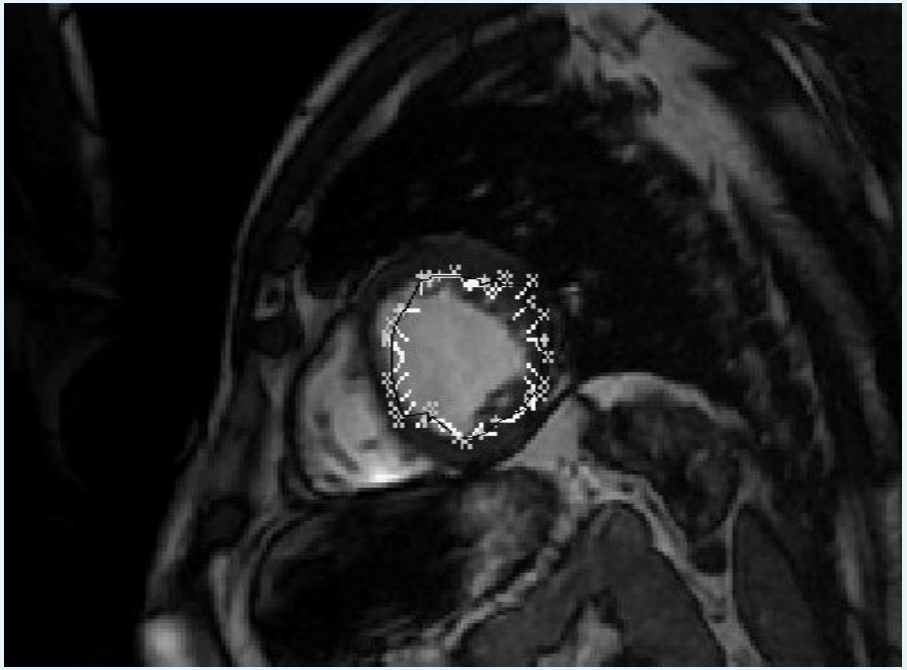
Cardiac Stress Analysis in 4-D

Roy Schestowitz

March 14th, 2013

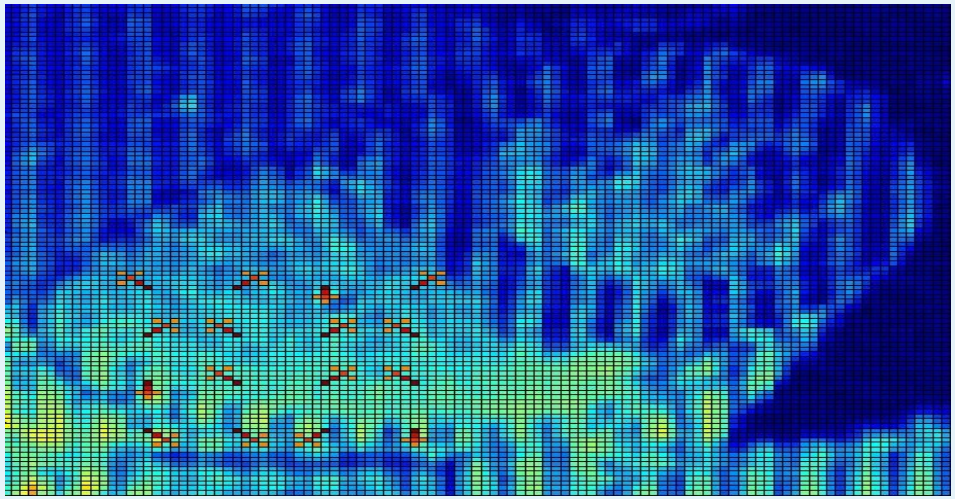
Goal

- Identity abnormality, necessitating
  - concise representation of heart sequences
  - directional decomposition of heart chambers



Data

- 3-D MRI data
- Acquired from different individuals
- Tagged MRI data simplifies tracking of anatomically-significant regions



Methods

- Edge detection
- Probabilistic matching to edges
- Finite sampling and discretisation
- Principal component analysis (PCA)
- Model-based matching to group

Edge detection

- Various filters investigated
- Predictive matching, dynamic thresholds
- Preliminary outlines of heart chambers
- Template aids as regularising term

Probabilistic matching to edges

- Edges change at each frame due to pulse
- Sample points in contours shift
  - based on intensity
  - based on neighbouring points
  - based on pulse cycle
- Weighting of factors finds probable match

Finite sampling and discretisation

- Subset of points along contours chosen
- Normalisation (geometric alignment, temporal calibration)
- Discrete-valued, concatenated coordinates
- Images/image sequences become vectors

Principal component analysis

- Process image sets represented concisely
  - eliminate geometric calibration error
  - align sequence based on cardiac cycle
- Build parameterised models for groups
- Develop comparison (dissimilarity) metric

Model-based matching to group

- Diagnosis and classification as follows:
  - vectorise given image sequence
  - compare to models of several groups
  - find best match
- Consistency in data processing essential
- Statistics derived from training data alone