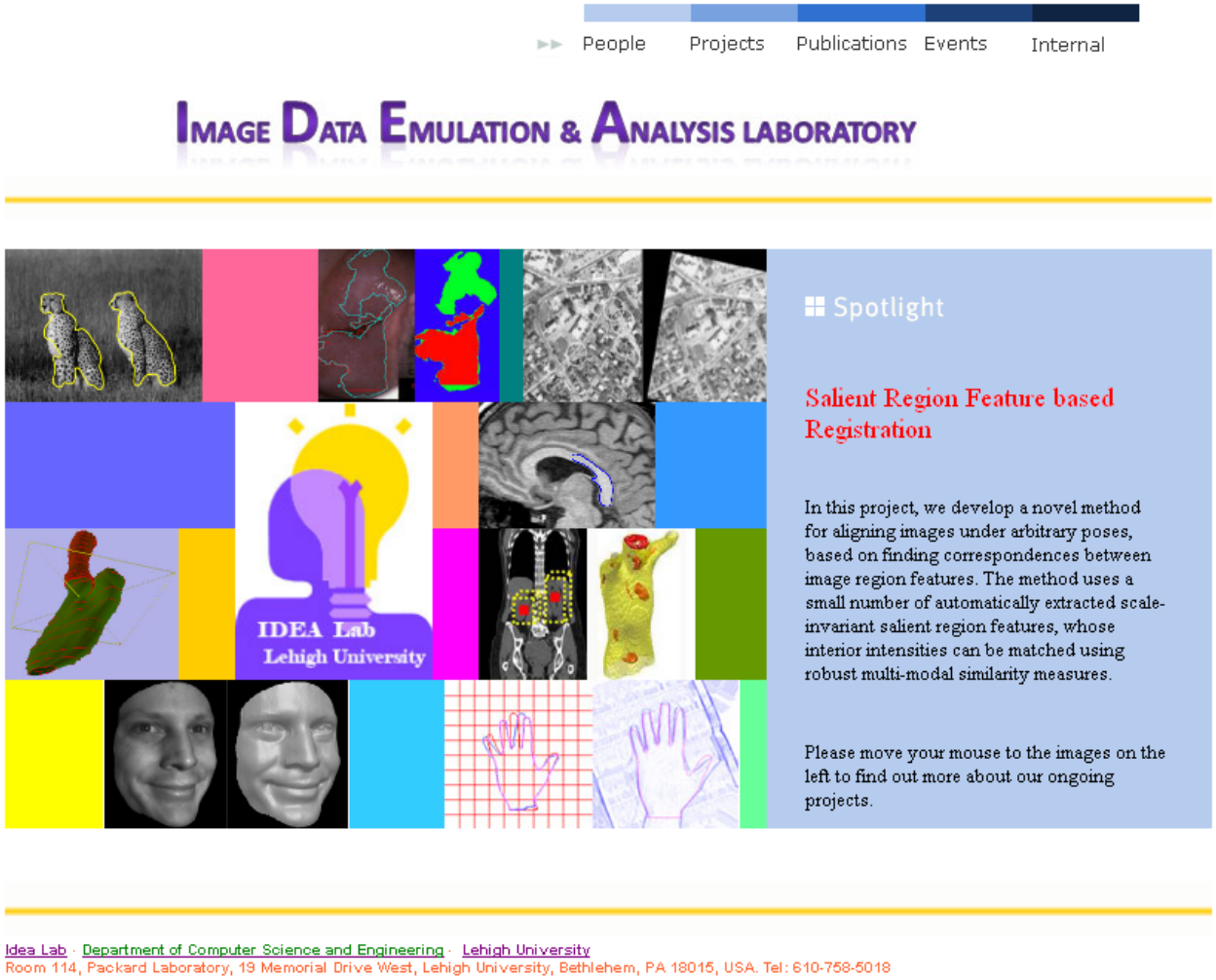
Image Data Emulation and Analysis (IDEA) Lab

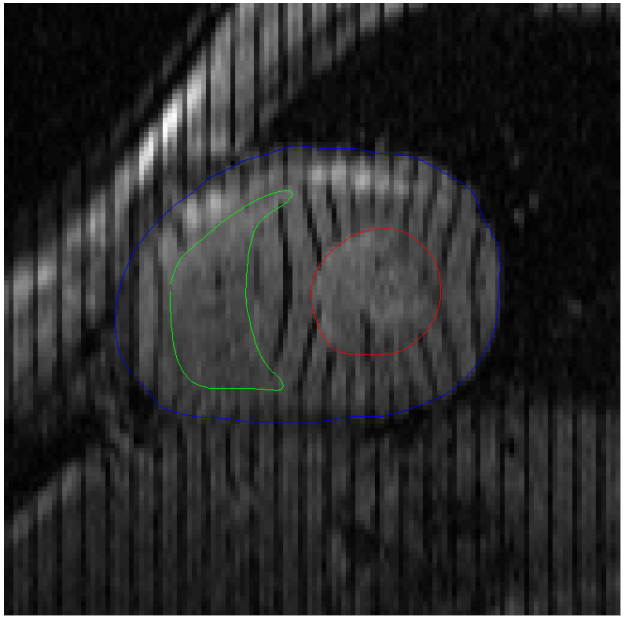
- Directed by: Prof. Xiaolei Huang, Lehigh CSE



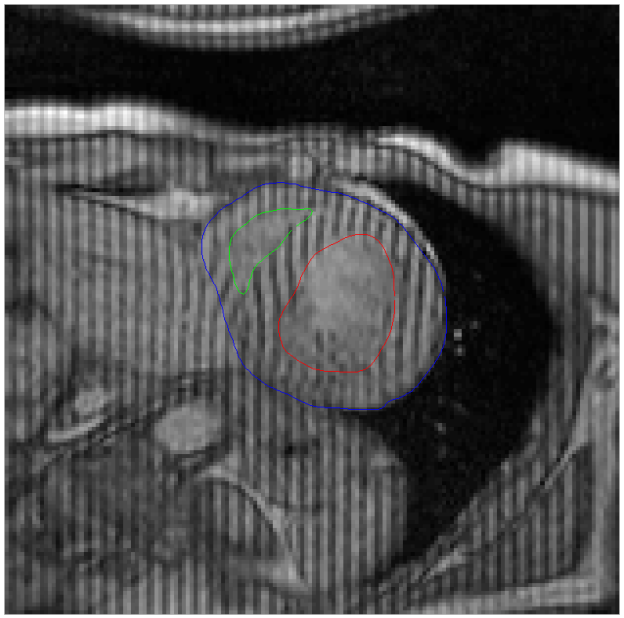
Computational Approaches to Biomedical Image Analysis

- Biomedical imaging and robust image analysis for image-guided diagnosis or therapy, information extraction, modeling
  - Aid doctors in accurate and reproducible diagnosis
  - Help understand the anatomical and physiological relationships in normal and diseased states
  - Help biologists and biophysicists in understanding and modeling complex biological pathways and systems.
  - Create intelligent vision systems that are capable of learning effectively and reasoning about multiple sources of information in order to achieve functions typical of human vision.

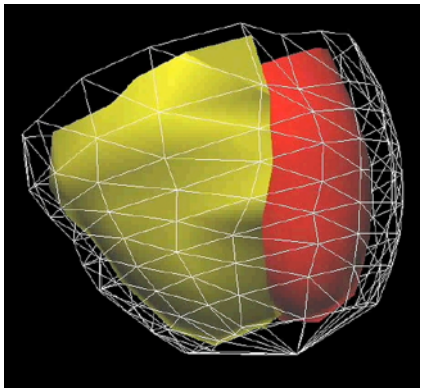
Heart Modeling and Wall Motion Analysis

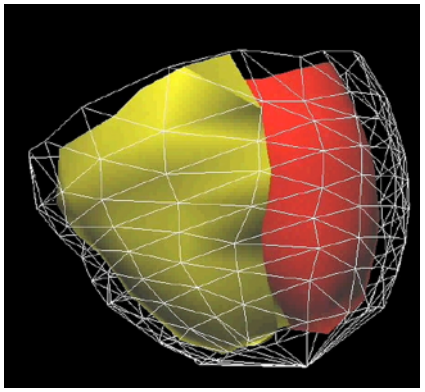


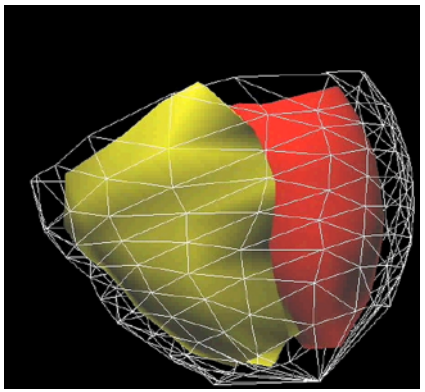
Normal heart



Diseased heart
after heart attack

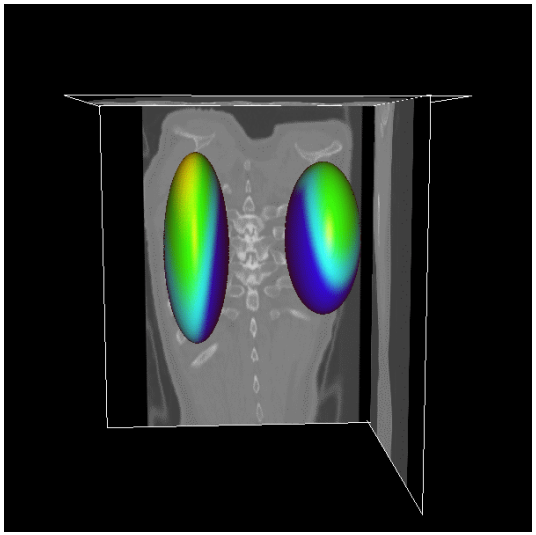




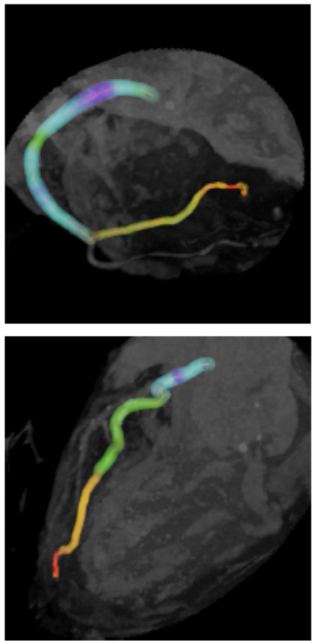


Finding Organ Boundary in 3D Volumetric Medical Images

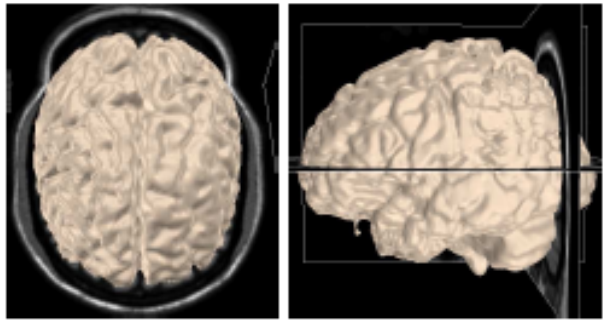
- Quantitative analysis of organ properties
- Detecting abnormalities
- Building statistical atlas for normal vs. abnormal anatomy.



Lung



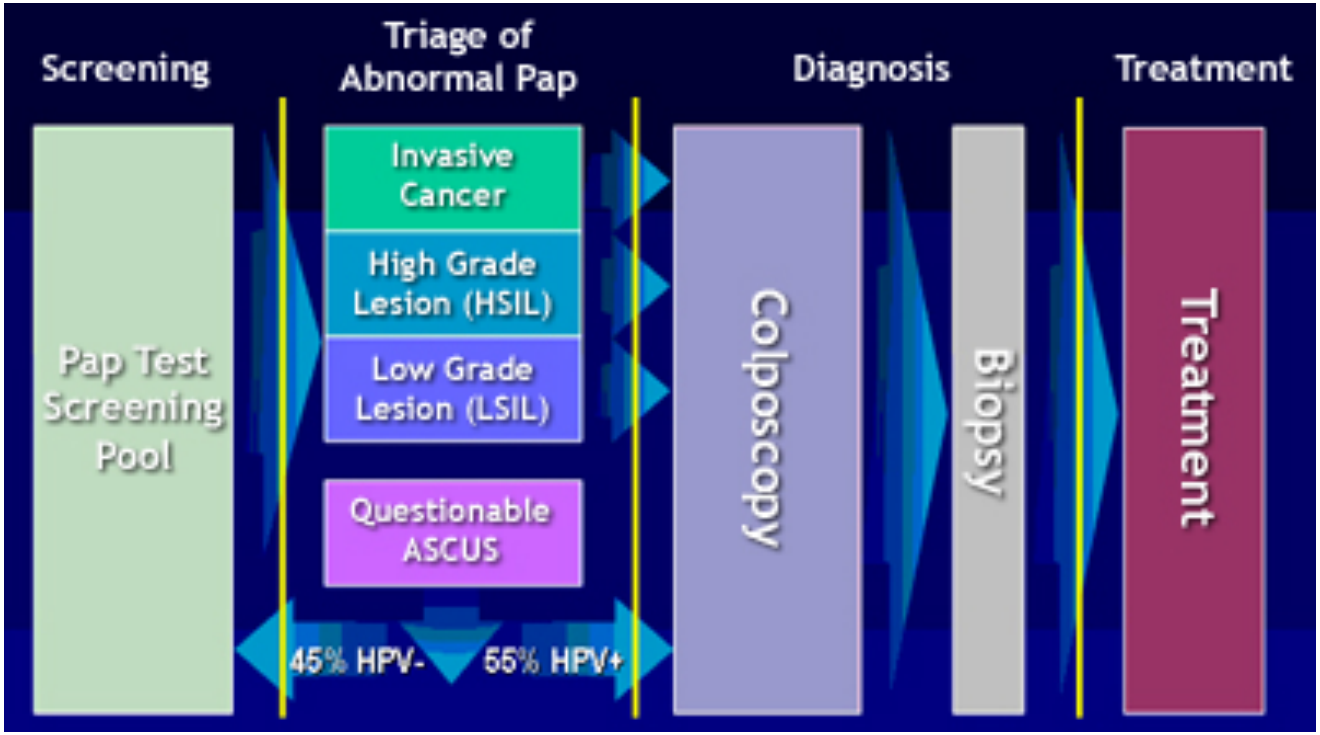
Coronary Arteries



Brain

Segmentation of organs in CT/MRI images and 3D visualization

Early Detection of Cervical Cancer



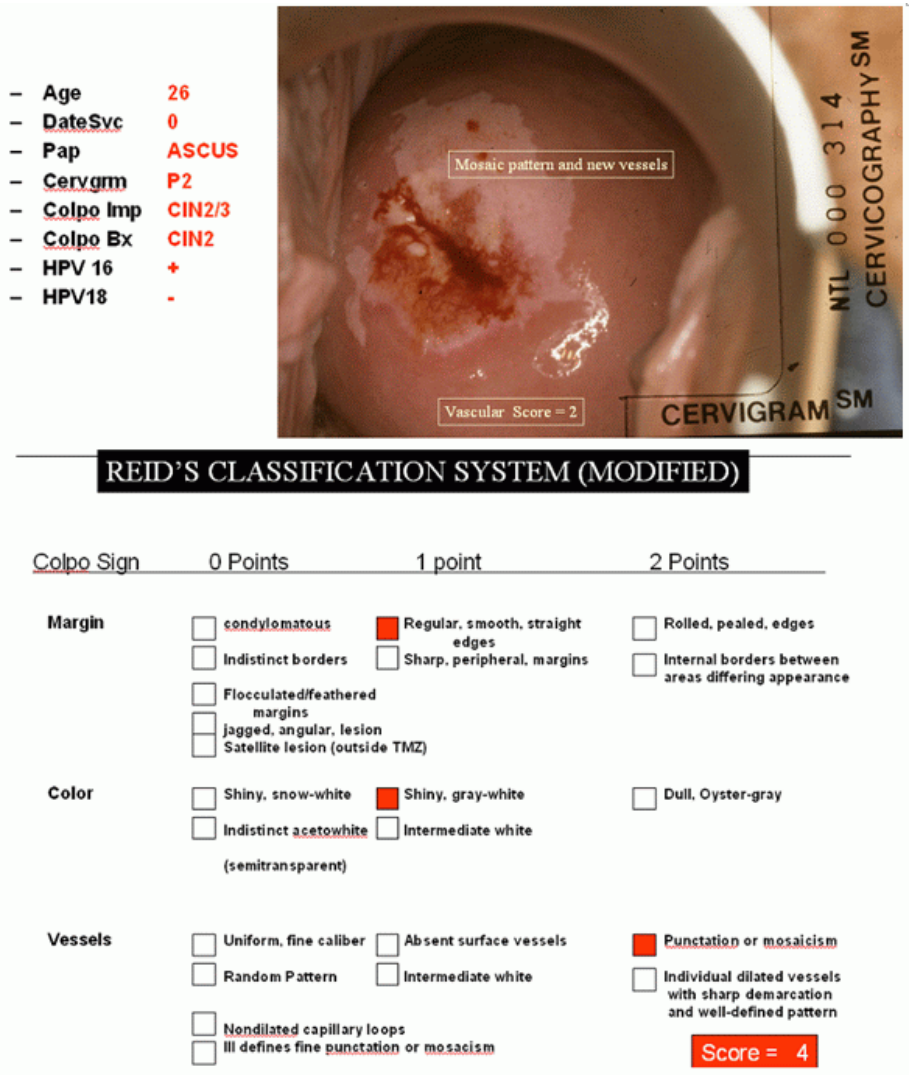
Picture Courtesy of Medispectra

60 mil. 5 mil. abnormal 2.5~3 mil.

- Pap smear: 15-35% false negative rate
- HPV Test: 20-30% false positive rate
- Administering both is costly
- In developing countries, access to screening and lab facilities is scarce.

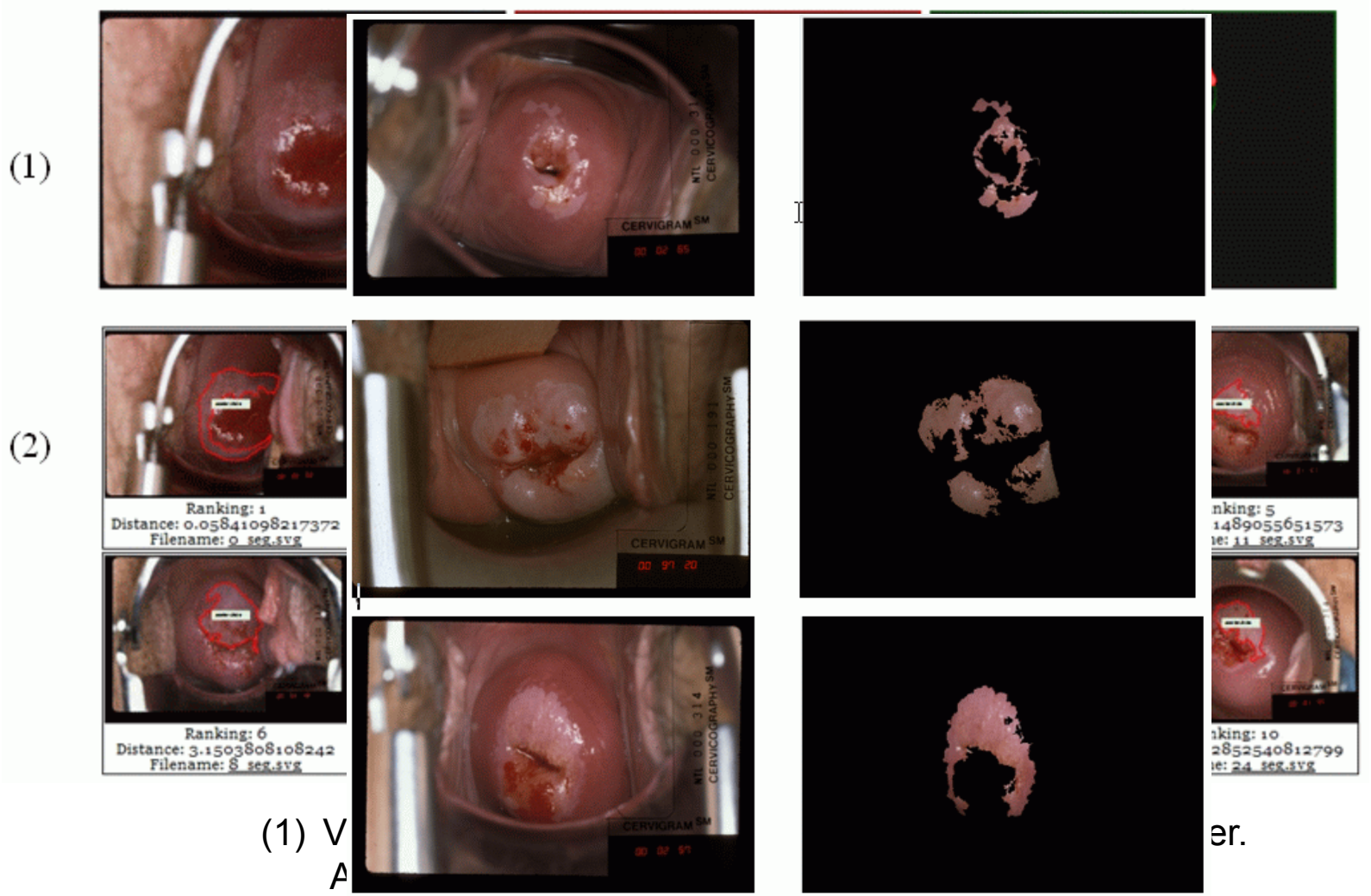
Computer-assisted Visual Interactive Recognition of Cervical Lesions

- Toward a more cost-effective way for early detection of cervical cancer by computer-assisted recognition of cervical lesions in cervigrams -- photographs of the cervix.
- Specific aims
  - Computer learning, from annotated cervigrams, of the correlation between image features and the severity of lesions.
  - Enable the search of medical records based on image content, e.g.
    - Web browser-based retrieval of similar cervigrams, along with diagnostic comments, from a large NCI/NLM archive
    - Online educational tool to help medical personnel learn how to grade cervical lesions.



NSF project co-PIs: Xiaolei Huang, Daniel Lopresti, Gang Tan, George Nagy (RPI), Joseph Patruno (LVH);
In collaboration with researchers at National Cancer Institute and National Library of Medicine.

Preliminary Results



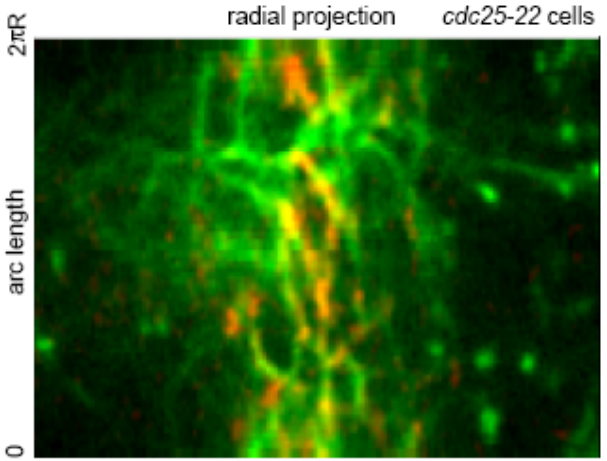
(1) V er.
A

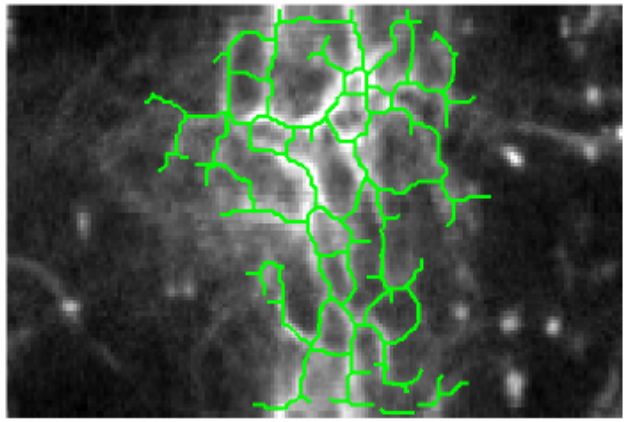
(2) Retrieval of similar cervigrams from the database based on Acetowhite region Properties (e.g. similar color, area, location)

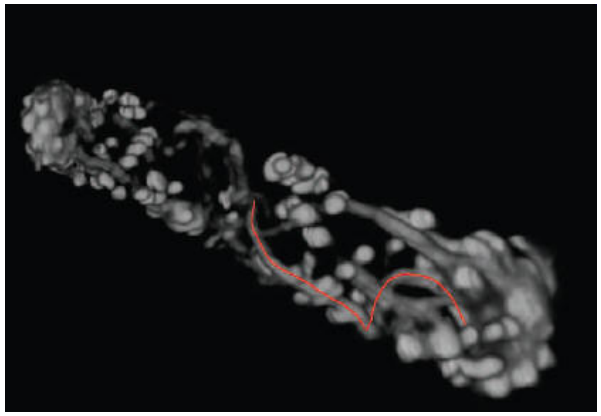
Computer Recognized Acetowhite Regions

Quantitative Computer Analysis of Biological Images

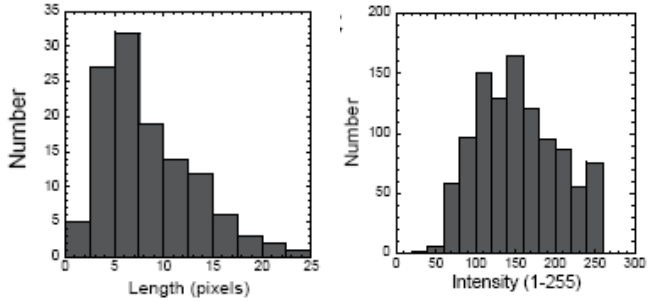
- Skeletonization of actin meshwork during cell division







red: nodes (Rlc1-RFP1)
green: actin filaments (GFP-CHD)

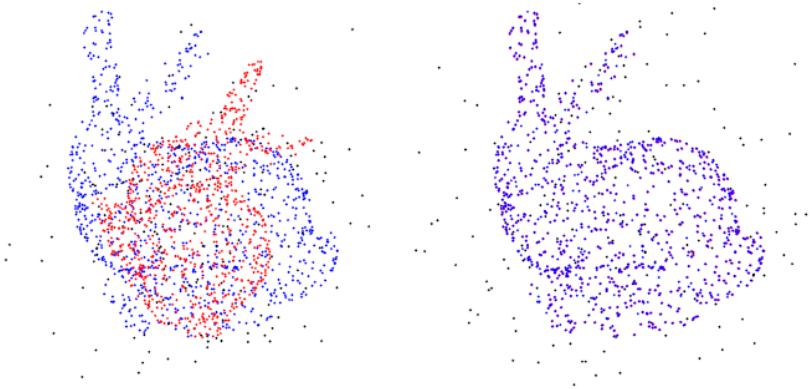


Filament length (left) and intensity (right) statistics, based on extraction result above

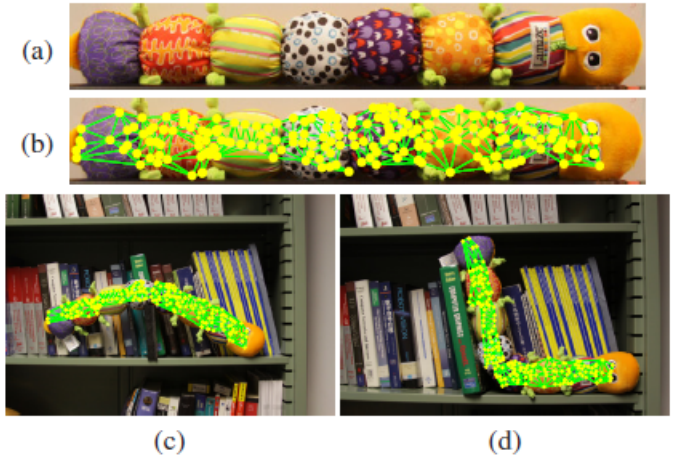
NIH project co-PIs: Dimitrios Vavylonis (Physics), Xiaolei Huang (CSE),;
In collaboration with Jian-Qiu Wu (Ohio State U.) and Tom Pollard (Yale)

IDEA Lab (Cont'd)

– Computer Vision



Alignment of Shapes regardless of noise



Detecting and matching objects that undergo Affine or articulated deformation

– Computer Graphics

User editing transfer: interactions on one cake is transferred to all others

Model-based Face Matching and 3D Facial Expression Retargeting