

Human Analytics: From Biometrics to Biomedicine

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Hugh Roy and Lillie Cranz University Professor



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computers people

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Changing the way ~~people~~ look at ~~computers~~
computers people

- Research Areas
 - Image Analysis
 - Computer Vision / Pattern Recognition
 - Data Analytics / Machine Learning

Challenge 1

What's in a Face?



Facial Analytics

- Biometrics
- Forensics
- Cognitive Psychology
 - Infer Emotional State
 - How do human's recognize faces?
- Medicine
 - Infer health status
- HCI

Challenge 1

What's in a Face?

ECCV 2012 Workshop
12th October 2012



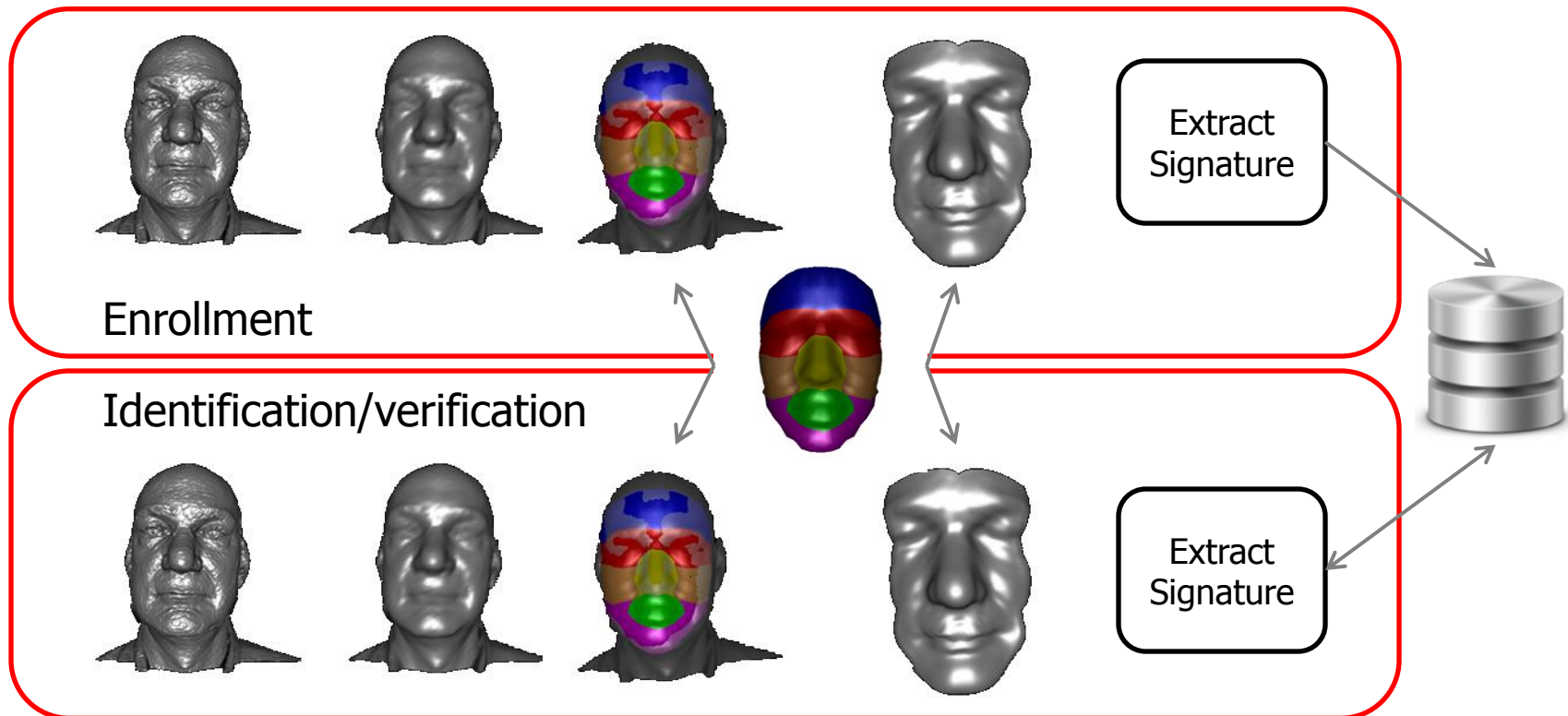
3D



3D-3D Face Recognition

Problem Statement:

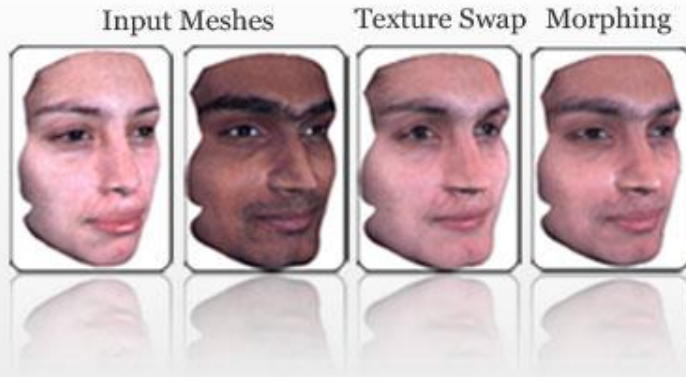
Given a 3D facial scan, determine or verify the identity of the subject.



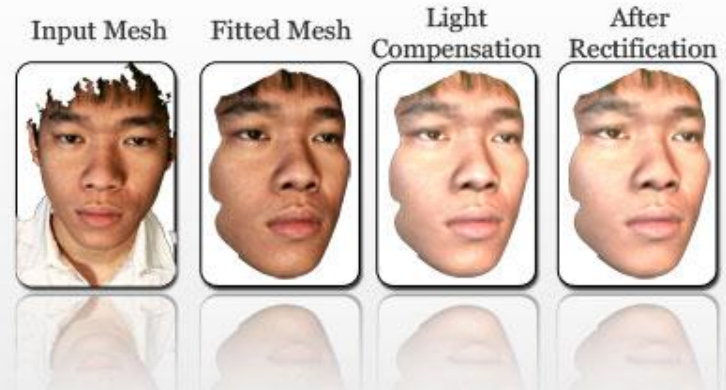
I.A. Kakadiaris, G. Passalis, G. Toderici, N. Murtuza, Y. Lu, N. Karampatziakis, and T. Theoharis, "Three-dimensional face recognition in the presence of facial expressions: An annotated deformable model approach," *IEEE Trans. on Pattern Analysis and Machine Intelligence*, vol. 29, no. 4, pp. 640 -- 649, 2007.

YOUR FACE IS YOUR PASSWORD

TEXTURE SWAPPING AND MORPHING



SPECULAR HIGHLIGHT REMOVAL



3D Face Recognition



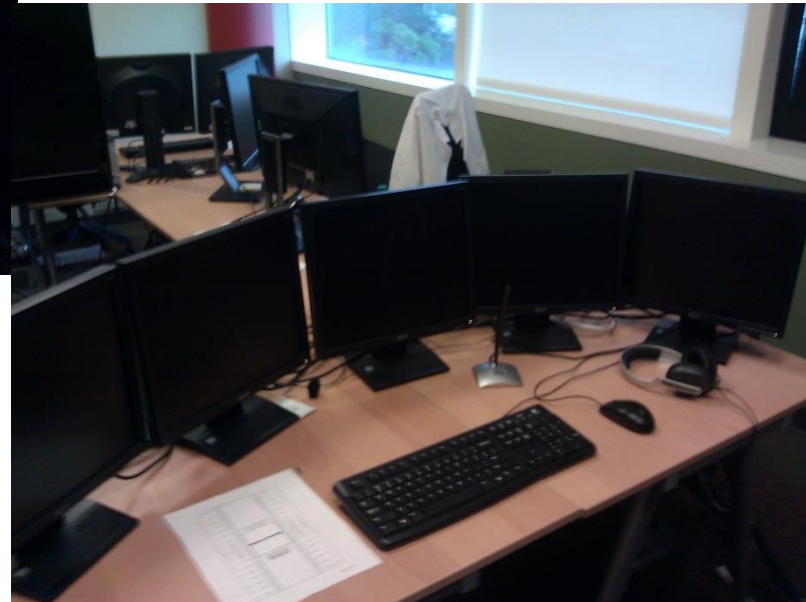
Winner of the 3D-shape section of the US NIST Face Recognition Vendor Test



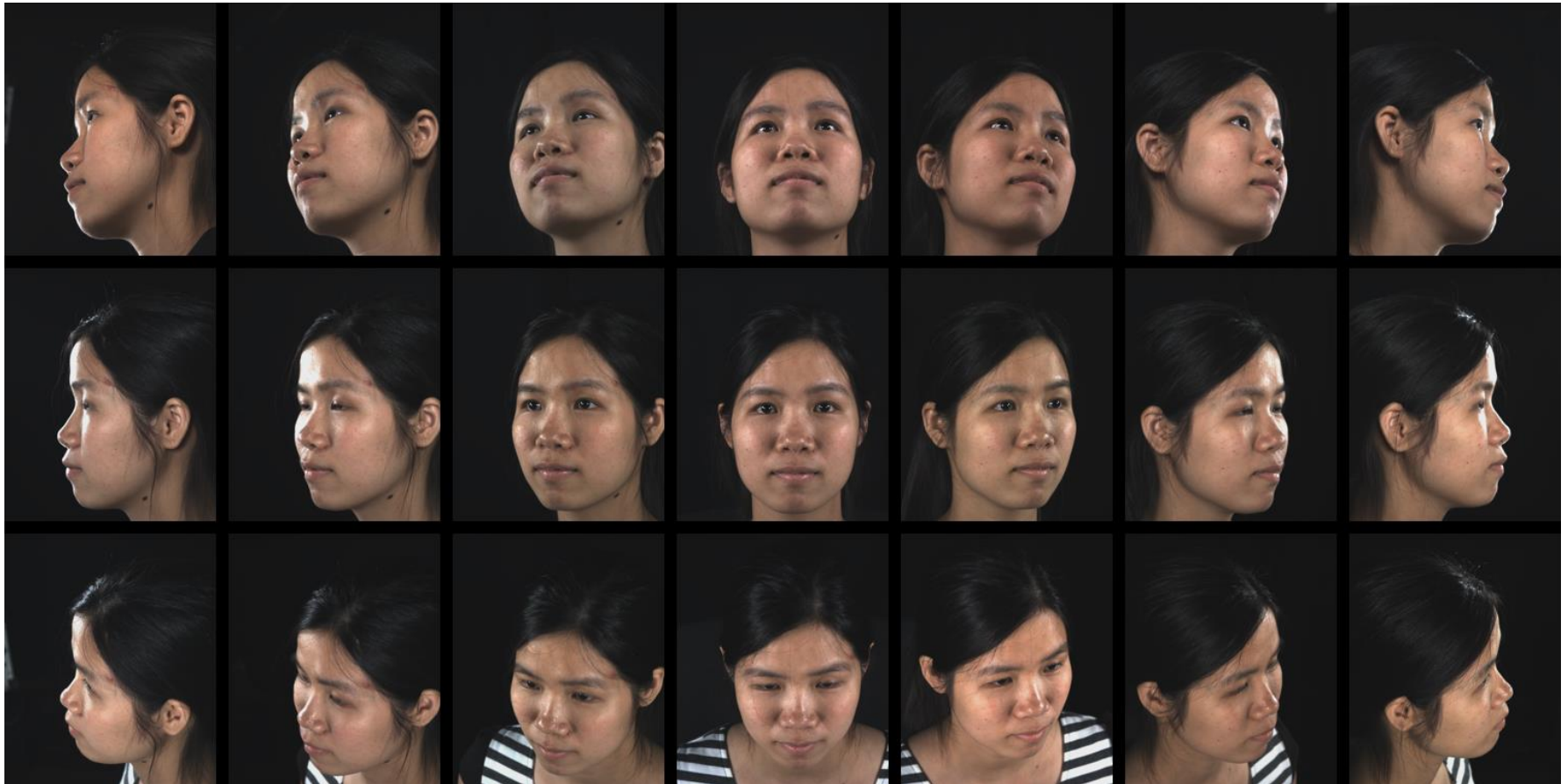
Publications (www.cbl.uh.edu)

- 3D-3D FR
 - Partial data
 - Twins
- 3D-2D FR
- Profile-Based FR
- Ear Recognition
- 3D Facial Expression Analysis
- 4D Facial Expression Analysis

21 Camera System



21 Pod Acquisition: 2D

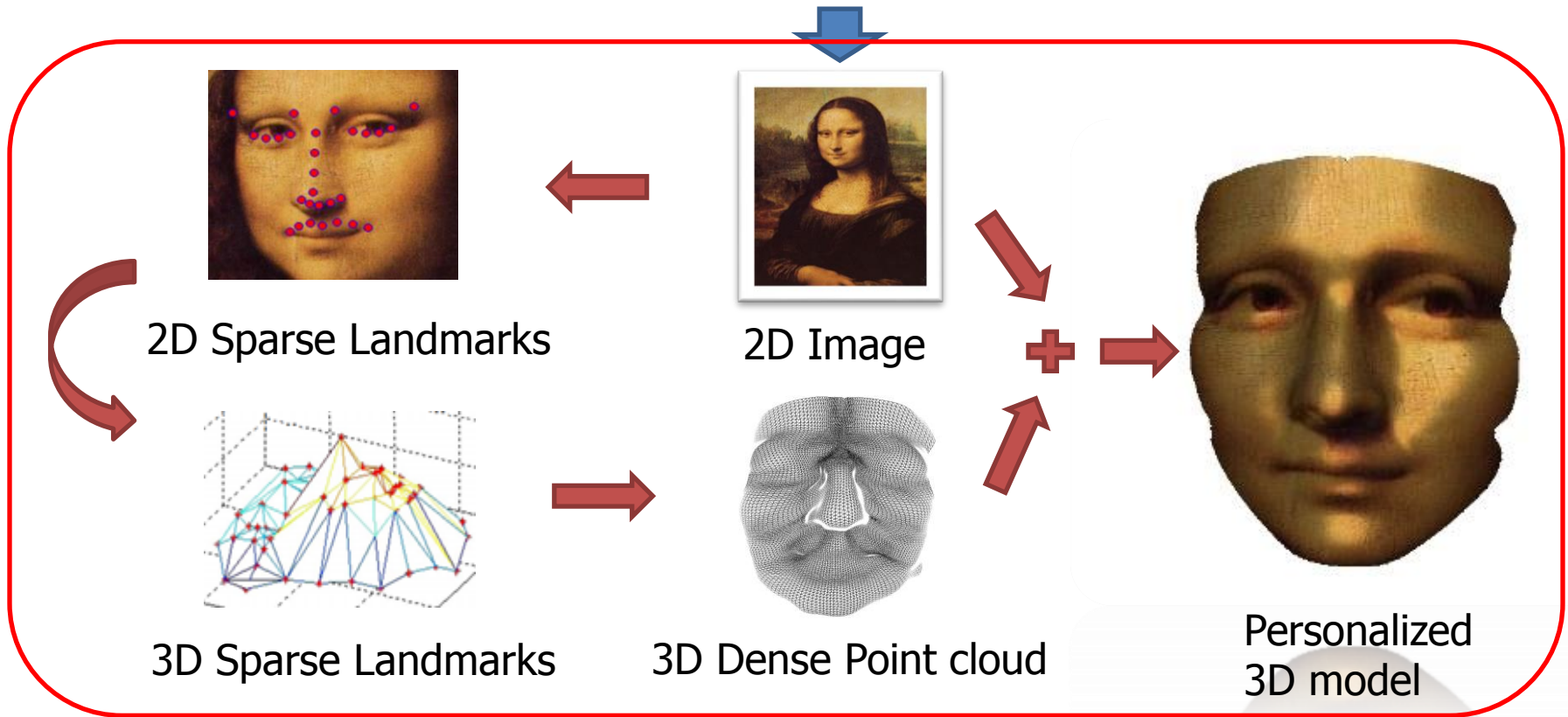


21 Pod Acquisition: 3D



Personalized 3D model from a single image

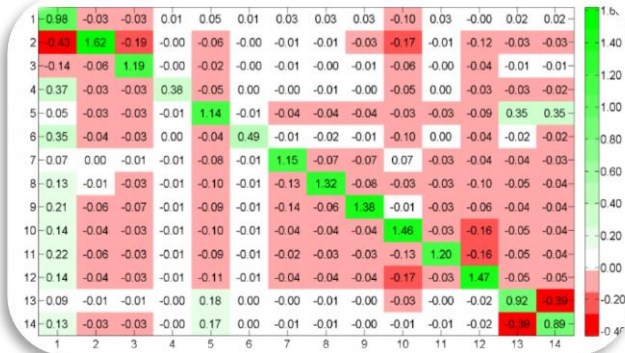
Problem Statement: Given a 2D image, reconstruct a personalized 3D face model.



P. Dou, Y. Wu, S.K. Shah, I.A. Kakadiaris, "**Robust 3D face shape reconstruction from single images via two-fold coupled structure learning**," In Proc. British Machine Vision Conference, Nottingham, UK, September 1-5, 2014

Hierarchical Multi-label Classification

Problem Statement: Given a segmented image and the conceptual hierarchy, annotate hierarchical labels to each subject.

Local prediction \times  = Global prediction

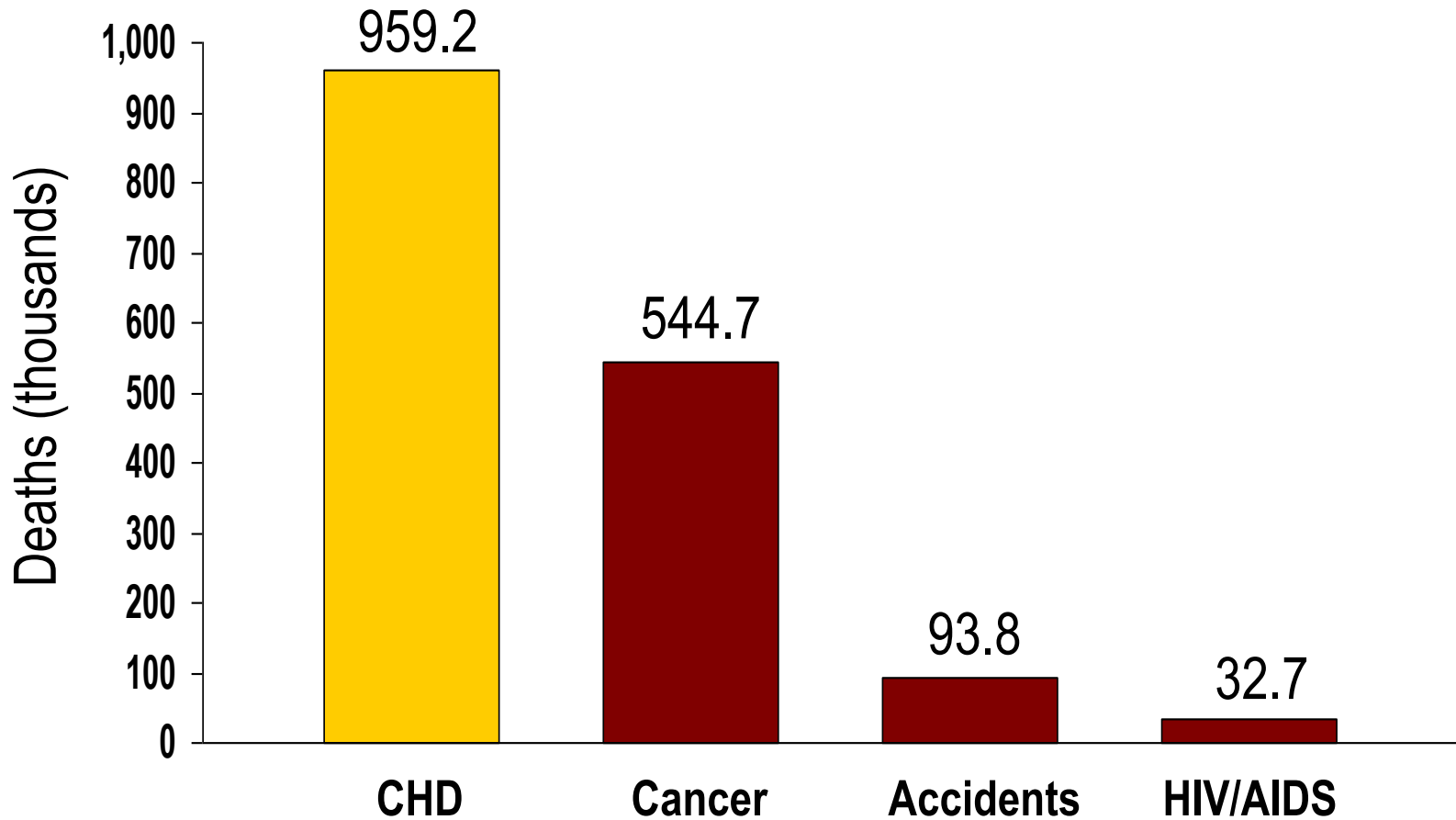
Fully associative matrix

L.F. Zhang, S.K. Shah and I.A. Kakadiaris, "Fully Associative Ensemble Learning for Hierarchical Multi-Label Classification," *In Proc. British Machine Vision Conference*, Nottingham, UK, Sep. 1-5, 2014.

Challenge 2

Can we predict your risk for a disease?

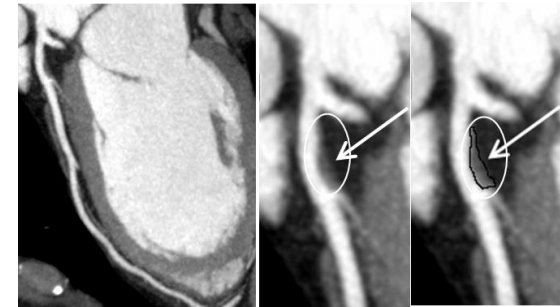
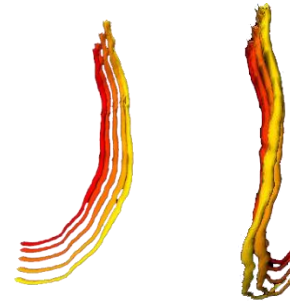
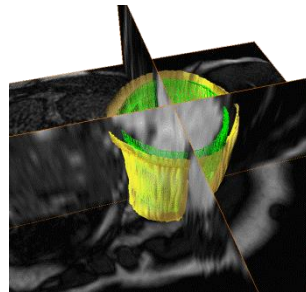
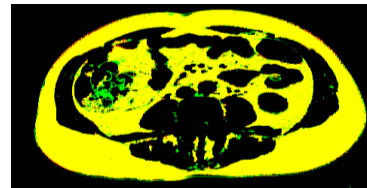
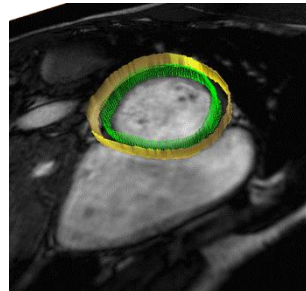
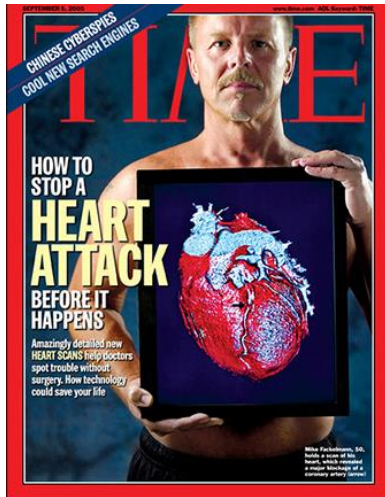
Magnitude of the Burden—Causes of Death in the United States



American Heart Association. *Heart and Stroke Statistical Update.*

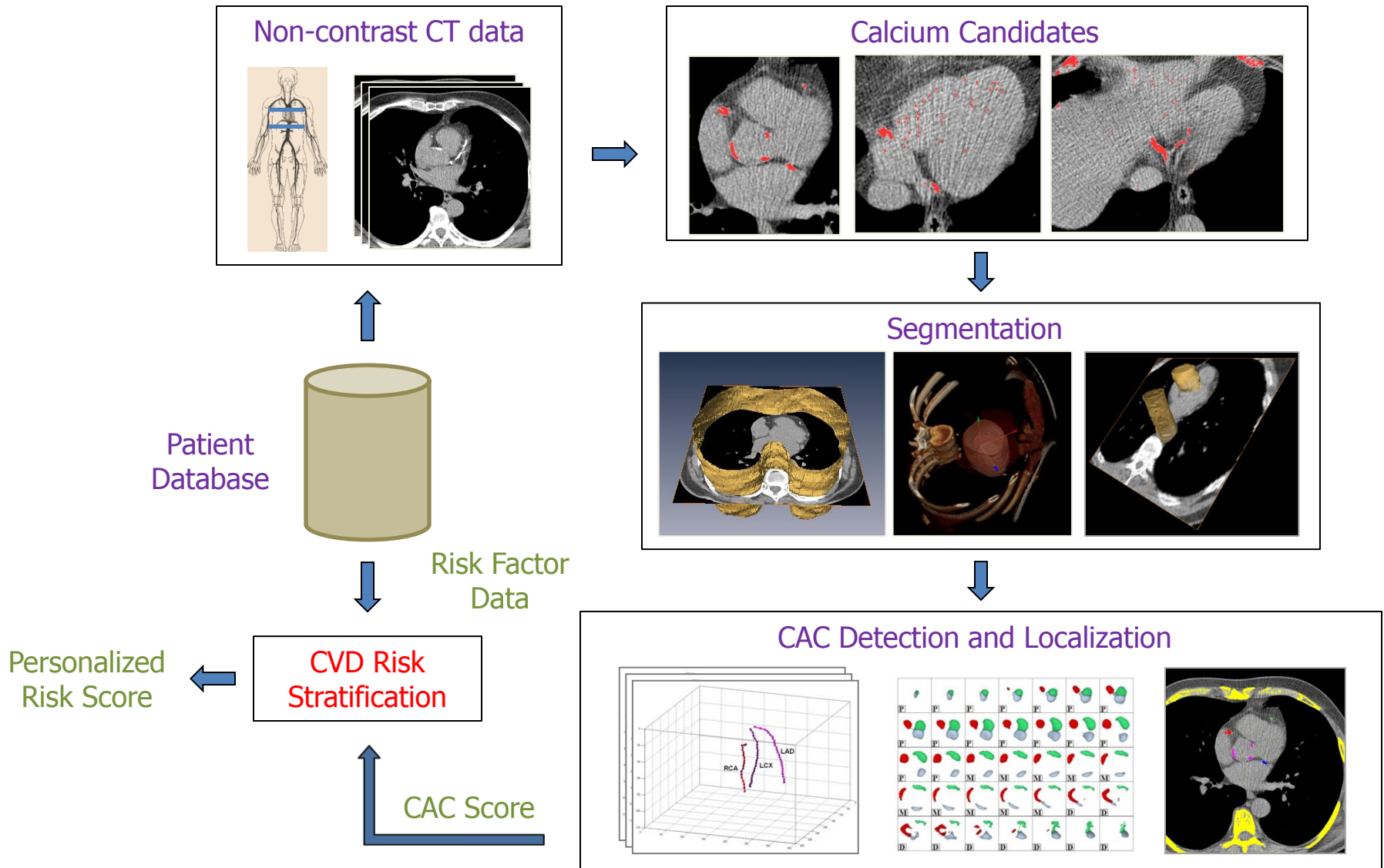
Cardiovascular Informatics

To develop the theoretical framework and computational tools to aid physicians in scoring the patients' vulnerability and **the likelihood of a future coronary event.**



<http://www.cbl.uh.edu/CARDIA>

Computational Methods for the Extraction of CVD Biomarkers from Non-contrast CT Data



Application Domains

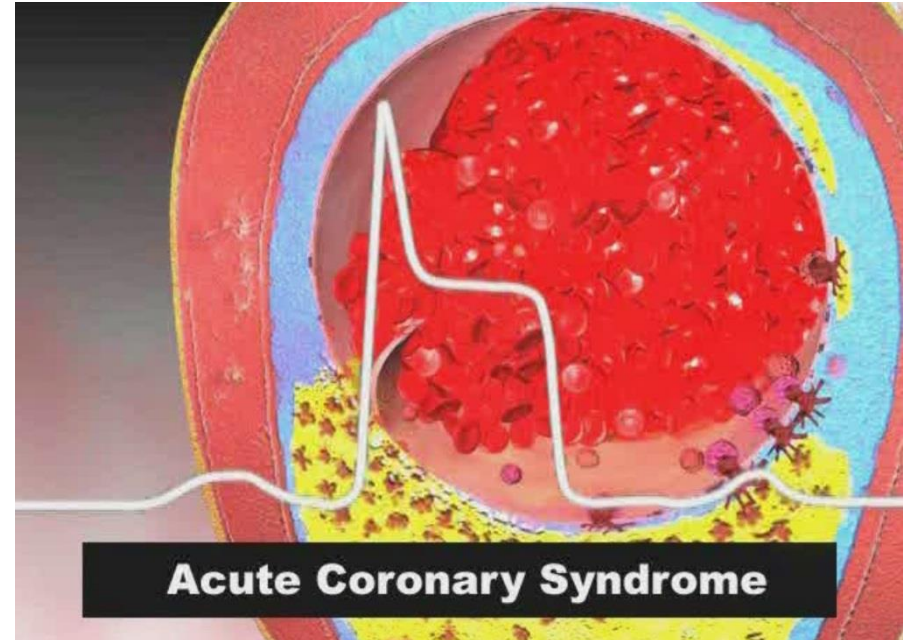
- Biometrics
 - Face Recognition
 - Ear Recognition
 - Facial Expression Analysis
- Health Computing
 - Cardiovascular Informatics
 - Cancer Informatics
- Neuroinformatics
 - Morphological Reconstruction of Neurons
 - Atlases: Mouse, Zebrafish
- Earth Computing
 - Emergency Management
 - Detection of Natural Resources

Publications: www.cbl.uh.edu

Journal Papers

2. B.A. Almogahed and I.A. Kakadiaris, "NEATER: Filtering of over-sampled data using non-cooperative game theory," *Soft Computing*, 2014 (In Press).
3. Y.H. Le, U. Kurkure, and I.A. Kakadiaris, "PDM-ENLOR for Segmentation of Mouse Brain Gene Expression Images," *Medical Image Analysis*, 2014 (In Press).
4. X. Zhao, T. Feng, W. Shi, and I.A. Kakadiaris, "Mobile user authentication using statistical touch dynamics images," *IEEE Transactions on Information Forensics and Security*, 2014 (In Press).
5. P. Moutafis and I.A. Kakadiaris, "Can we do better in unimodal biometric systems? A Rank-based Score Normalization Framework," *IEEE Transactions on Cybernetics*, 2014 (In Press).
6. D.R. Chittajallu, N. Paragios, and I.A. Kakadiaris, "An explicit shape-constrained MRF-based contour evolution method for 2D medical image segmentation," *IEEE Journal of Biomedical and Health Informatics*, vol. 18, no. 1, pp. 120 – 129, 2014.
7. S. Balocco, C. Gatta, F. Ciompi, A. Wahle, P. Radeva, S. Carlier, G. Unal, E. Sanidas, F. Mauri, X. Carillo, T. Kovarnik, C.-W. Wang, H.-C. Chen, T.P. Exarchos, D.I. Fotiadis, F. Destrempes, G. Cloutier, O. Pujol, M. Alberti, E.G. Mendizabal-Ruiz, M. Rivera, T. Aksoy, R. Downe, and I.A. Kakadiaris, "Standardized evaluation methodology and reference database for evaluating IVUS image segmentation," in *Computerized Medical Imaging and Graphics*, vol. 38, no. 2, Barcelona, Spain, 2014, pp. 70 – 90.
8. M. Vrigkas, V. Karavasilis, C. Nikou, and I.A. Kakadiaris, "Matching mixtures of curves for human action recognition," *Computer Vision and Image Understanding*, vol. 119, pp. 27–40, 2014.
9. P. Perakis, T. Theoharis, and I.A. Kakadiaris, "Feature fusion for facial landmark detection," *Pattern Recognition*, vol. 47, no. 9, pp. 2783–2793, 2014.
10. K.N. Tran, A. Gala, I.A. Kakadiaris, and S.K. Shah, "Activity analysis in crowded environments using social cues for group discovery and human interaction modeling," *Pattern Recognition Letters*, vol. 44, pp. 49–57, Jul. 2014.
11. X. Zhao, G. Evangelopoulos, D. Chu, S. Shah, and I.A. Kakadiaris, "Minimizing illumination differences for 3D to 2D face recognition using lighting maps," *IEEE Transactions on Cybernetics*, vol. 44, no. 5, pp. 725–736, May 2014.
12. X. Yan, I. A. Kakadiaris, and S. K. Shah, "Modeling local behavior for predicting social interactions towards human tracking," *Pattern Recognition*, vol. 47, no. 4, pp. 1626–1641, Apr. 2014.

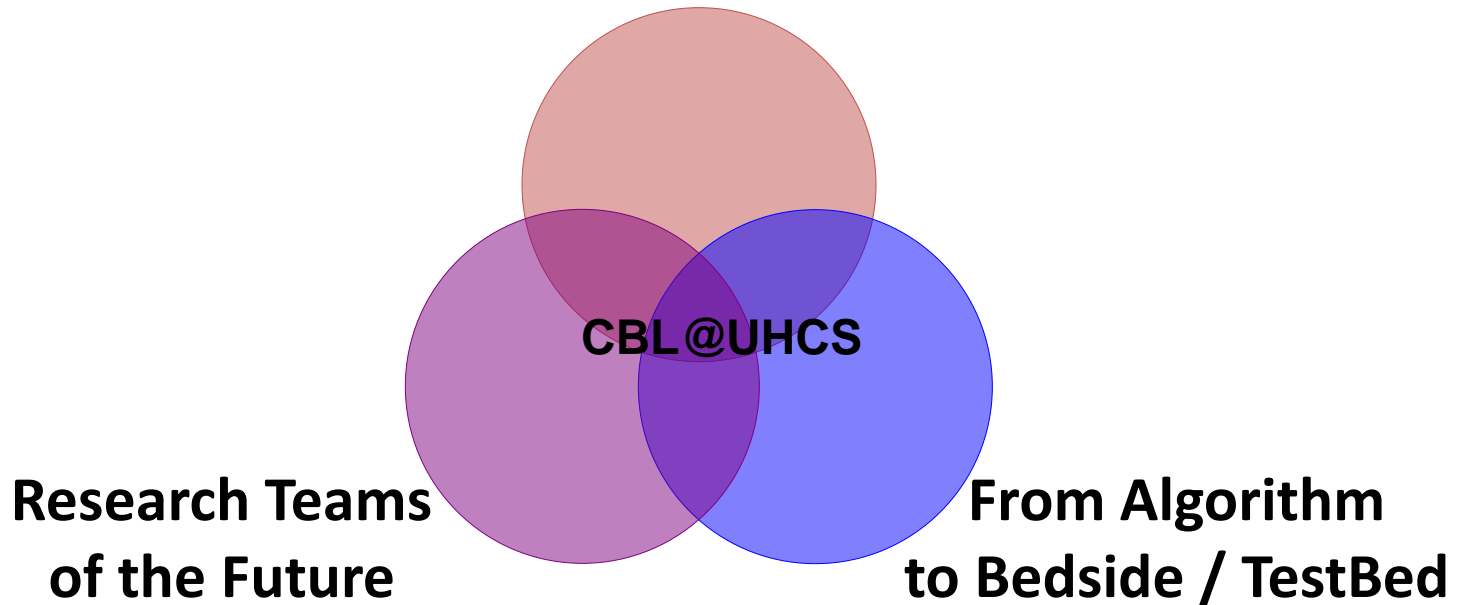
Press Coverage



- ABC 13 News
- Fox News
- Local2 News
- Discovery Channel

CBL Roadmap

**New Computational Tools
For Scientific Discovery**



Alumni: Academia



BCM
Baylor College of Medicine



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Alumni

Name	Position at CBL	Dates at CBL	Current Position
Abby Corrington	High School Student	05/2006 – 08/2006	Student, Rice University, Houston, TX
Alberto Santamaria-Pang	Postdoctoral Fellow	01/2003 – 08/2008	Image Analysis Scientist, GE Global Research, Niskayuna, NY
Alok N. Bandekar	Ph.D. Student	05/2002 – 12/2006	Research Scientist, Visigen Inc., Houston, TX
Amol Pednekar	Ph.D. Student	01/1999 – 12/2003	MR Clinical Scientist, Philips Healthcare, Cleveland, OH
Anders Sundin	Visiting Scholar	04/2002	
Barbara Morales-Quinones	REU Student	06/2008 – 08/2008	Senior, University of Puerto Rico, Mayaguez Campus
Barry Walsh	International Intern	07/2004 – 06/2005	Financial Engineer Consultant - First Derivatives
Carlos Barron	Ph.D. Student	10/1998 – 12/2003	Professor, CIMAT, Mexico
Celeste Williams	Postdoctoral Fellow	03/2002 – 10/2003	Sr. Scientist, Siemens Molecular Imaging, Hoffman Estates, IL
Celia Ayala	REU Student	05/2006 – 08/2006	
Charalampos Mavroforakis	International Intern	09/2008 – 10/2008	B.Sc. Student, Athens University of Economics and Business, Athens, Greece.
Chris Harding	Ph.D. Student	07/1997 – 05/2001	Associate Professor, Dept. of Geological and Atmospheric Sciences, Iowa State University, Ames, IA
Christian Uehara	Postdoctoral Fellow	07/2002 – 06/2004	Software Engineer, Micrometrics Instrument Corporations, Atlanta, GA
Chrysanthi Chaleva Ntina	M.Sc. Student	01/2011 – 05/2011	M.Sc. Student, Dept. of Computer Science, UH

Alumni: Research Labs & Industry (2)

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BIOTECHNOLOGIES, INC

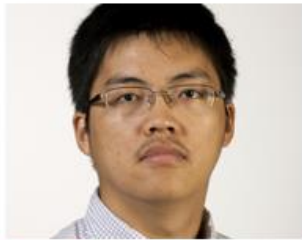


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Alumni

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Abby Corrington	High School Student	05/2006 – 08/2006	Student, Rice University, Houston, TX
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Christian Uehara	Postdoctoral Fellow	07/2002 – 06/2004	Software Engineer, Micromeritics Instrument Corporations, Atlanta, GA
Chrysanthi Chaleva Nina	M.Sc. Student	01/2011 – 05/2011	M.Sc. Student, Dept. of Computer Science, UH

Ph.D. Students



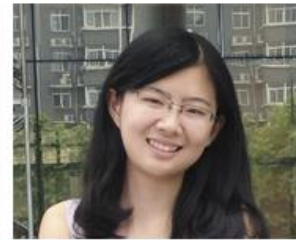
Pengfei Dou
314 HBS



Le Anh Vu Ha
330 HBS



Paul Hernandez
316 HBS



Mengjun Leng
326 HBS

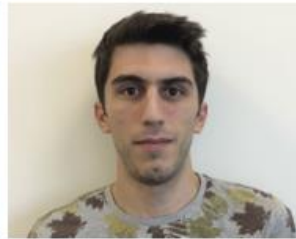
Undergraduate Student



Ali Memariani
316 HBS



Panagiotis Moutafis
326 HBS



Nikolaos Sarafianos
330 HBS



Yuhang Wu
314 HBS



Stephen Meriwether

Stephen Meriwether
330 HBS

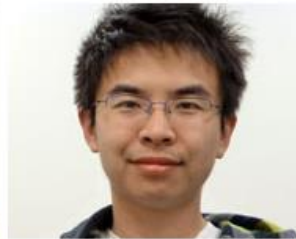
M.Sc. Student



Xiang Xu
314 HBS



Stanislav Yotov
318 HBS



Lingfeng Zhang
318 HBS



Zakariyya Mughal

International Interns



Abraham Baez
320 HBS



Oman Magana
320 HBS



Lhoussine Omary
328 HBS

Research Experience

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219 PGH

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