



Complex System Monitoring, Modeling and Analysis Laboratory

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Research Roadmap

Engineering & Biological Systems

Manufacturing System

Cardiovascular System



Monitoring: *wireless sensor network,
supervisory control and data acquisition (SCADA)*

Modeling & Analysis

- Multiscale modeling of complex system dynamics and subsystem interactions
- Sensor-based system informatics and control
- Real time detect and diagnose the quality and reliability of system operations
- System performance prognosis, maintenance and optimization

Theoretical Foundations

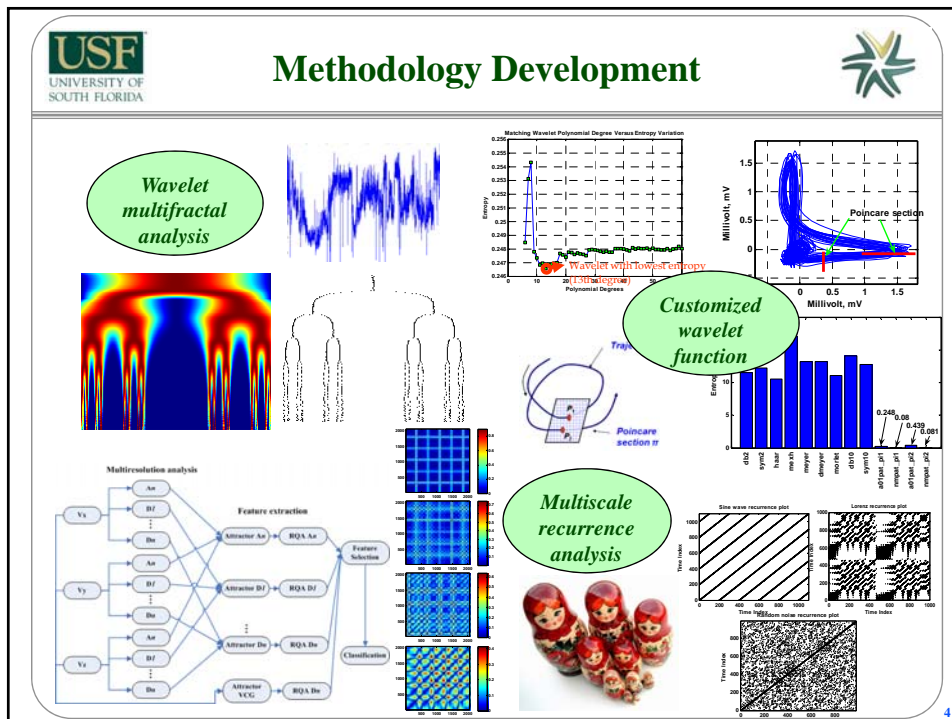
Nonlinear dynamics, statistics, signal processing, control theory

- Optimal wavelet function: nonlinear adaptive design of wavelet function
- Local recurrence predictive modeling for system prognostics
- Multiscale recurrence analysis: complex system recurrent dynamics study
- Spatiotemporal octant-wise analysis of cardiac electrical dynamics

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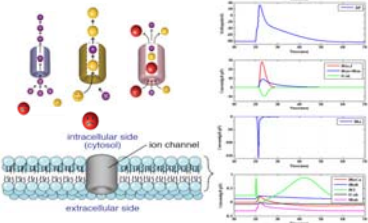
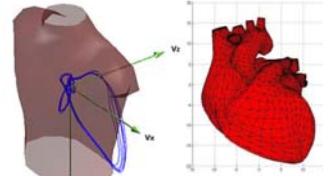


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- ❑ **H. Yang**, "Multiscale recurrence quantification analysis of spatial cardiac vectorcardiogram (VCG) signals," *IEEE Transactions on Biomedical Engineering*, Vol. 58, No. 2, p339-347, 2011
- ❑ D. Dawson, **H. Yang**, M. Malshe, S. T. S. Bukkapatnam, B. A. Benjamin and R. Komanduri, "Linear affine transformations between 3-lead (Frank XYZ leads) vectorcardiogram and 12-lead electrocardiogram signals," *Journal of Electrocardiology*, Vol. 42, No. 6, p. 622-630, 2009.11
- ❑ S. T. S. Bukkapatnam, R. Komanduri, **H. Yang**, P. Rao, W. Lih, M. Malshe, L. M. Raff, B. A. Benjamin and M. Rockley "Classification of atrial fibrillation (AF) episodes from sparse electrocardiogram (ECG) datasets," *Journal of Electrocardiology*, Vol. 41, No. 4, p. 292-299, 2008.7
- ❑ **H. Yang**, S. T. S. Bukkapatnam and R. Komanduri, "Nonlinear adaptive wavelet analysis of electrocardiogram signals," *Physical Review E* 76, 026214, 2007
- ❑ **H. Yang**, "Multiscale recurrence analysis of complex physiological rhythmic dynamics," *Proceedings of 2010 Industrial Engineering Research Conference*, June 8, Cancun, Mexico (*Best Paper in Computer and Information Systems*)
- ❑ **H. Yang** and S. T. Bukkapatnam, "Recurrence based performance prediction and prognostics in the complex manufacturing systems," *Proceedings of 2009 Industrial Engineering Research Conference*, May 30, Miami, FL (*Best Paper in Manufacturing and Design*)

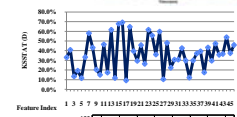
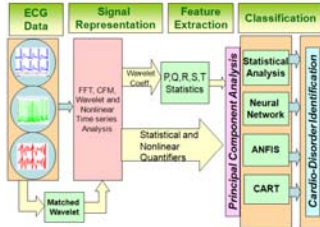




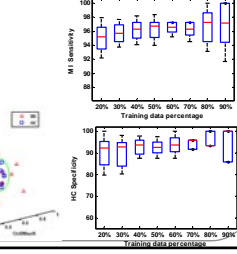
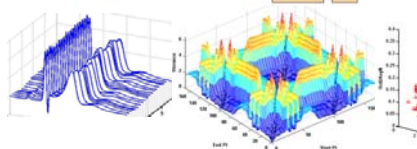
Modeling



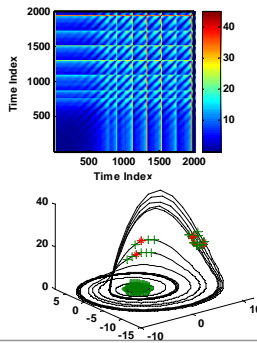
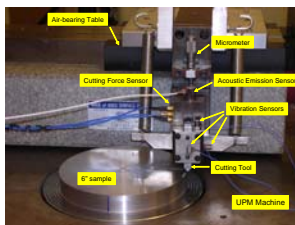
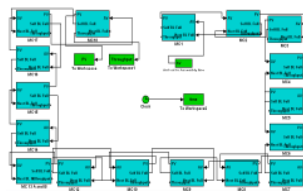
Atrial fibrillation



Heart Attack



Continuous flow modeling of multistage assembly line system



Local recurrence predictive modeling

