### **Biology and Medicine**

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## Overarching themes

Managing uncertainty and complexity in:

- Multiresolution modeling and analysis of (nongeneric, designed, evolved, heterogeneous) multiscale systems
- Integrated communications and computing for control of/with pervasive, distributed, embedded networks
- From data to information to knowledge to decision to action in complex systems

#### Domain themes

- Science of reverse (and forward) engineering biological control networks
  - gene regulation and signal transduction
  - hormonal, immunology, cardiovascular
  - neuroscience, neuroengineering
  - muscular, locomotion, prosthesis
  - active sensing, vision, proprioception
  - attention and consciousness
  - group dynamics, population, epidemics
- (Figuring out what and how it works, and what we can do to affect it.)

#### Domain themes

- Systems technology and instrumentaion for medicine and biomedical research
  - Intelligent operation rooms and hospitals, from data to decision
  - Systems-guided surgery and therapy
  - Hardware and soft tissue integration
  - Fluid flow control for medicine and biological assays
  - Prosthesis





# Vignettes and challenges

- Drug delivery, pacemakers, artificial kidneys, control of MRI machines
- High focus ultrasound for hyperthermia treatment of tumors
- Automated anesthesia
- Lots of specific biological reverse engineering
- Fine motor control devices (science article)
- Endoscopy