# IMAG Challenge #2

Higher level models and modeling approaches that integrate multiple physiological (and possibly psychological) systems in order to better understand the human response

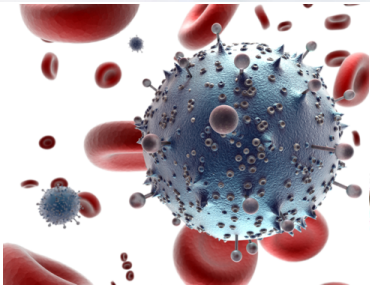**C. Alberto Figueroa, Thomas ("Ted") Dick, Silvia Salinas Blemker**

Defining Challenge #2

Higher level models and modeling approaches that integrate multiple physiological (and possibly psychological) systems in order to better understand the human response to ...
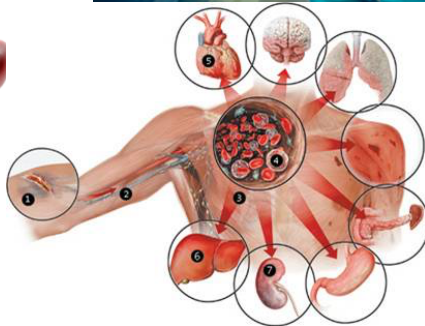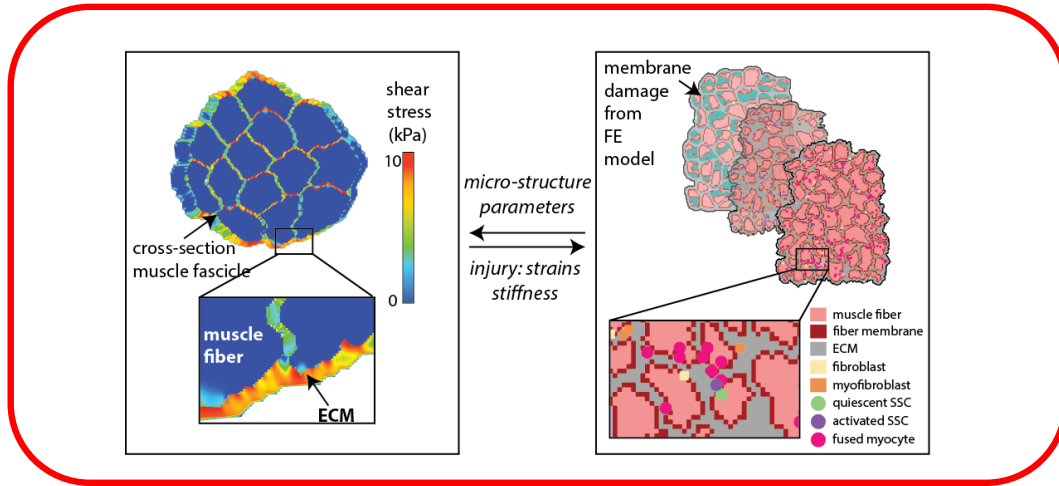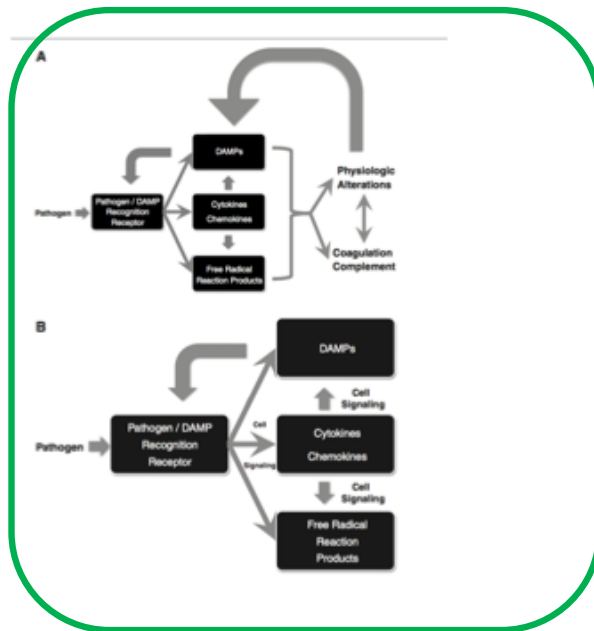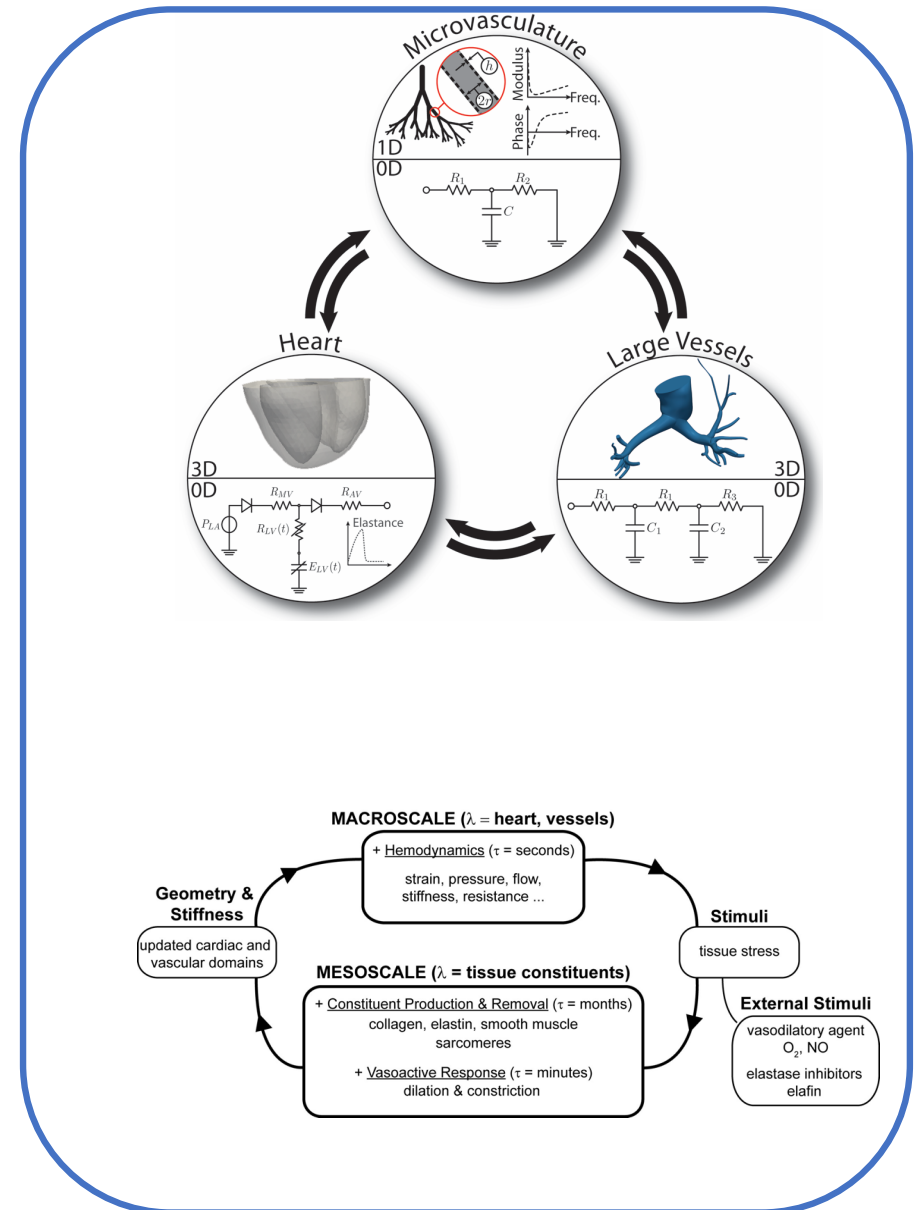
Accomplishments:

Drugs & exercise in muscle disease

Stress & chemically-mediated remodeling of vascular tissues


System inflammatory process in sepsis

Addressing sparse data

- Formulation to define '**homeostatic equilibrium**' in vascular networks.

- Time-dependent predictions present a major challenge in human studies as compared to animal studies

- Need to compliment our clinical non-invasive data with experimental data

- Leveraging human and animal data for models

Impact

- Effect of drugs on the entire cardio-pulmonary system.
- Effects of drugs on muscle at the organ scale.
  - Revealed robustness of muscle regeneration and how various cell types can compensate based on perturbed conditions.
- New mechanistic descriptions for patient stratification
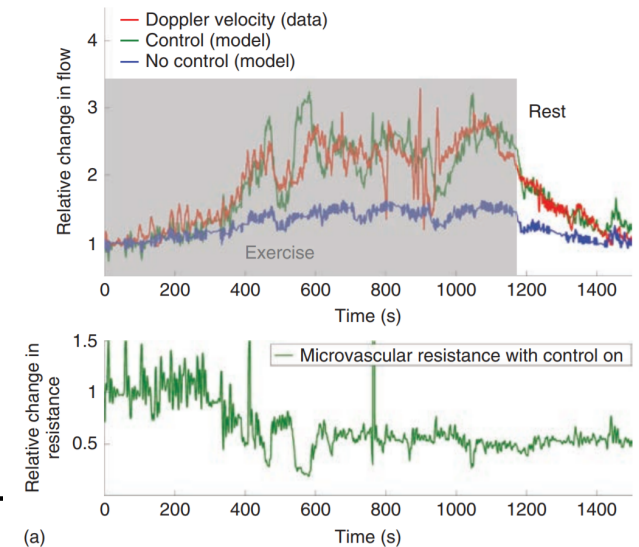- Revealing the concept of variability as a biological property
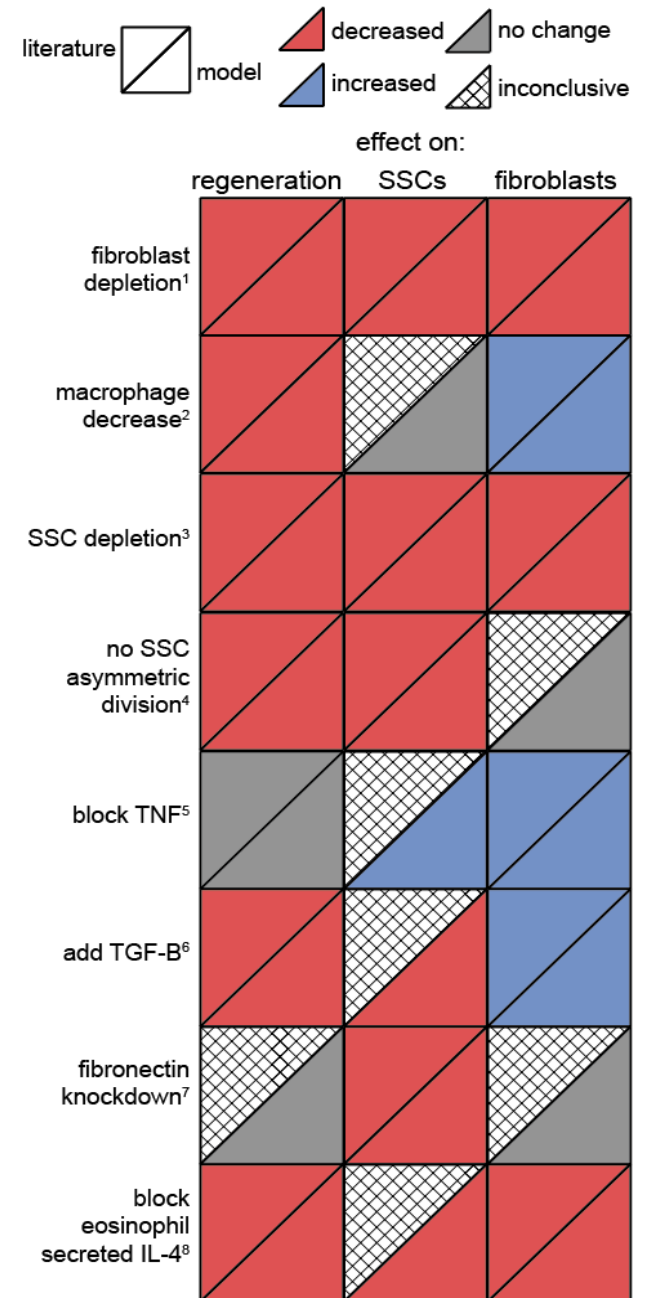
Challenges

- New way of thinking to "break" models. Even to encourage publishing "broken-ness" of models?
  - Example of micro-gravity, hypoxia, etc.
- Model predictions require new experiments for validation
  - Time-varying
  - Non-invasive imaging

- There are no commonly accepted strategies for Incorporation of multiple modeling domains, e.g. agent-based models w. FE models

- Methods to address time granularity (e.g., time variation of measurements, and in tissue micro-environment vs. physiological response)

Challenges

- Making further connections:
  - incorporate models of short-term hemodynamic adaptations (e.g., baroreflex, local autoregulations).

- Mixture theory methods for cardiac G&R (instead of kinematic growth approaches) are needed predictive model

- Incorporation of agent based models to predict drug responses in our meso-macro-scale model

- From a clinical perspective: Dealing with confounding phenomena (for instance, normal growth and pathologic remodeling) in a controlled manner.

Questions?