

ABET Addendum

Team #32 - Alexa Roa

Project Needs

1. *Non-generalized cardiac model* that captures chamber-specific differences and responses on a molecular level across ventricles and atria.
2. *Simulation-based method* to study heart failure mechanisms without requiring repeated cell culture experiments in the long-term.
3. *Biologically accurate model* that represents cardiac tissue response to mechanical stretch and stress-induced remodeling.

Major Constraints

1. *Time* required for tissue culture, mechanical stretch experiments, RNA-seq processing, and running computational simulations.
2. *Variability* in quality and success of cardiac tissue differentiation and culture.
3. *Limited Availability and Quality* of lineage-specific molecular data for preliminary model construction and validation.

Major Engineering Standards

1. *21 CFR Part 58* - Good Laboratory Practice for Nonclinical Laboratory Studies
2. *ISO 13022:2012* - Medical Products containing Viable Human Cells – Application of Risk Management and Requirements for Processing Practices
3. *ASME V&V 40-2018* - Assessing Credibility of Computational Modeling through Verification and Validation for Decision Making

Ethical, Environmental, or Societal Concerns

- in the long-term, project will reduce repeated wet-lab experimentation and consumption of cellular resources by allowing computational testing
- model predictions need proper experimental validation before being used for clinical conclusions and diagnoses

Teamwork and Leadership

- team responsibilities and project components were delegated between an experimental team (2 members) and computational team (3 members).
- The full team met weekly, with guidance from our mentor, Dr. Christopher Anderson, to discuss progress, set goals and deadlines, complete shared assignments, and give feedback across subprojects.

Significant Motivating Factors

- interest in completing a meaningful senior design capstone project and contributing significant findings to the field of cardiac research.
- opportunity to learn dry-lab skills such as computational modeling and python coding.
- opportunity to contribute to a project with potential research value beyond the course.

Most Innovative and/or Entrepreneurial Ideas

- developing a chamber-specific cardiac model instead of a generalized heart model
- modeling 3 cardiac cell types: cardiomyocytes, fibroblasts, and macrophages to increase biological relevance
- using fibroblast-derived extracellular matrix (ECM) on cardiomyocyte cells to improve biological accuracy of engineered cardiac tissues