Motivation

**Mitrail Valve (MV) Regurgitation**
- Most common form of valvular heart disease
- Significant mortality & morbidity rates
- Traditional treatment: MV replacement

**MV Repair**
- Better preservation of heart function & long-term survival
- Requires experienced surgeon & pre-operative planning
- Efficient training/planning tools to optimize intervention outcome
- Development of computational MV models
- Models remain simplifications

→ Assess clinical applicability of models by validation against comprehensive ex-vivo data

Data Acquisition

**Mechanical Simulator**
- In-vitro closed-loop left heart simulator
- Design optimized to allow for echocardiography (TEE) and microCT acquisitions

**State-of-the-Art Geometrical Model**
- Physiological point distribution model
- Based on 9 anatomical landmarks
- Marginal Space Learning framework

**Biomechanical Modeling**
- Transverse isotropic linear elasticity
- Co-rotational finite elements method

Ex-Vivo MicroCT

**High-Fidelity Model**
- Identify annulus and papillary muscle locations
- Convert mask to mesh
- Segment chordae tendineae

→ Novel path tracing approach

Model Extraction

- Sparse model extraction
- Full model segmentation
- Chordae tracing / mesh decomposition

Model Validation

**Geometric Comparison of Anatomical Models**
- TEE model vs. microCT model
- MV excised from ovine heart
- Measured clinically-related parameters

**MV Closure Computation (Biomechanics)**
- Based on end-diastolic TEE model
- Pressure profile: 0 mmHg to 120 mmHg

Conclusion

**Contributions**
- Novel complete model validation pipeline
- Bridge between ex-vivo and clinical modalities
- Integration of geometric and functional models
- Controlled setup to acquire images from invasive and non-invasive modalities at almost identical conditions
- Robust algorithms to extract reproducible models
- First experiments on real data
- Utilized TEE model can accurately represent important biomarkers

**Future Work**
- Experiments on more specimen
- Evaluation of prediction power of current and future in-vivo computational frameworks

References