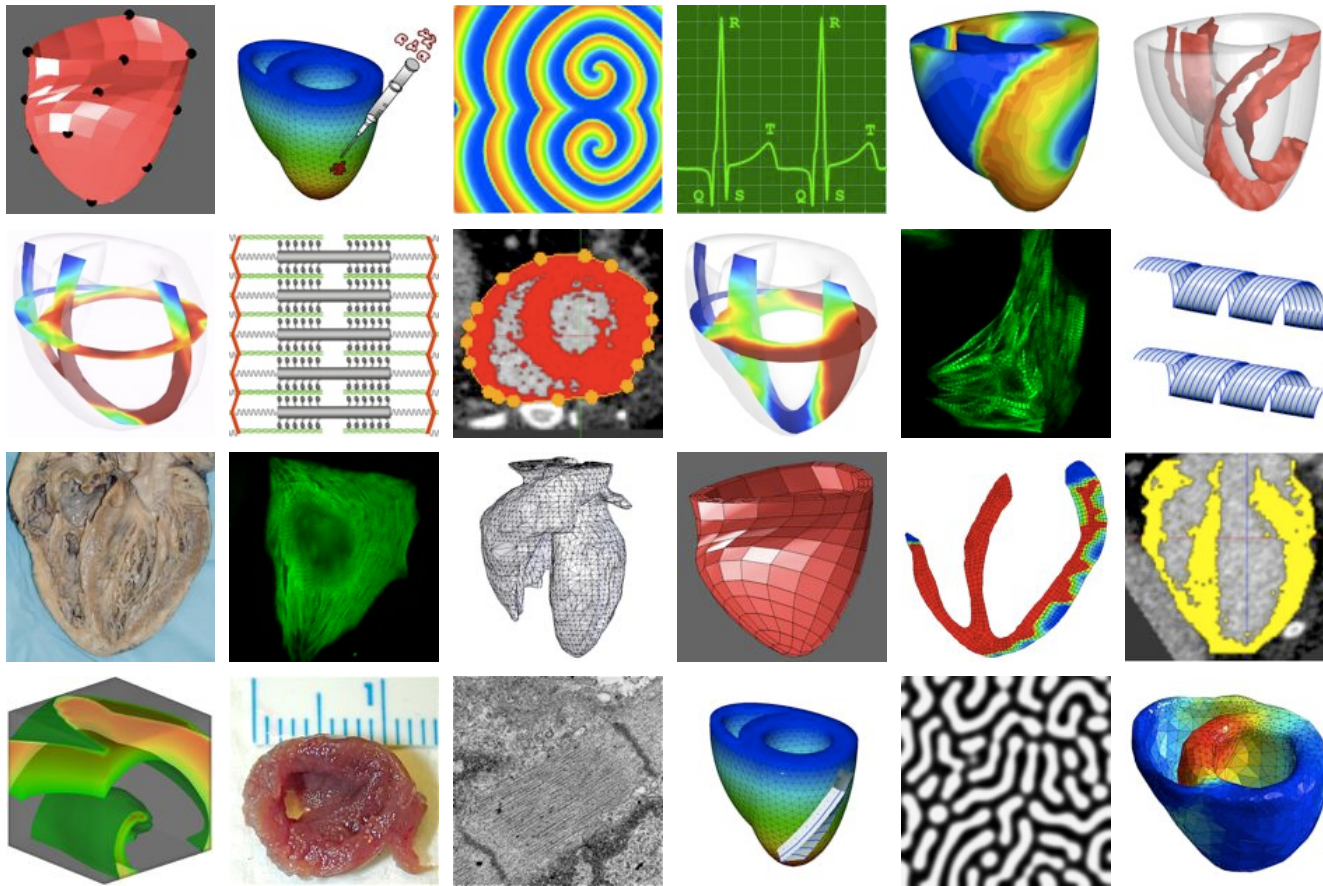


modeling pathologies within the living heart project

martin genet, arnaud toutain, lik chuan lee, brian baillargeon, julius guccione, ellen kuhl



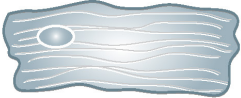
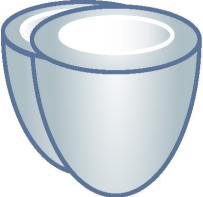

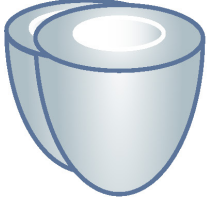


eccentric & concentric cardiac growth

can we predict growth of the heart?

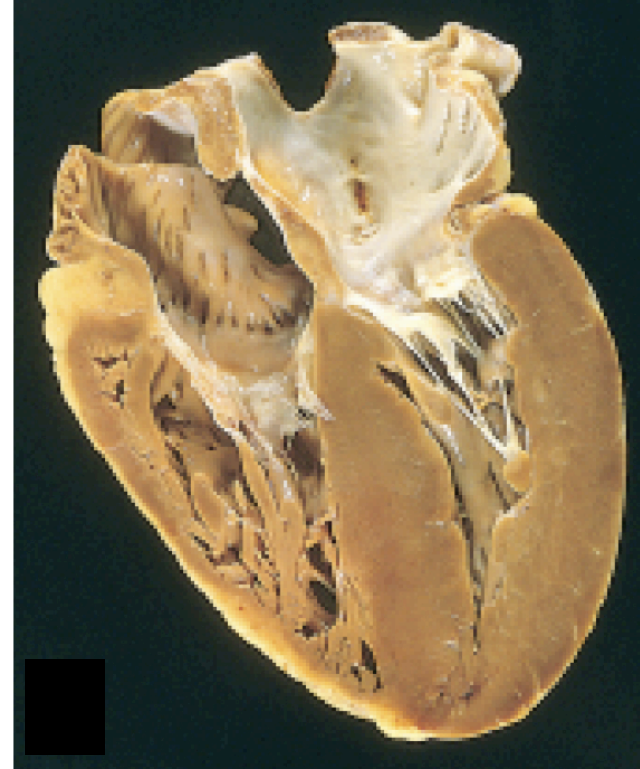
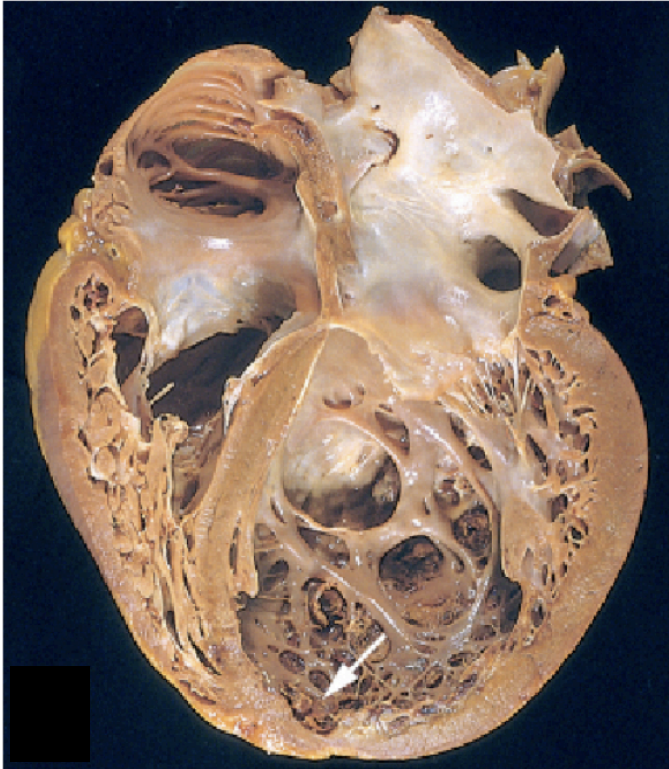
$$F^g = \vartheta_{\perp}^{\perp} \mathbf{I} + [\vartheta_{\parallel}^{\parallel} - \vartheta_{\perp}^{\perp}] \mathbf{n}^{\text{myo}} \otimes \mathbf{n}^{\text{myo}}$$

concentric & eccentric growth

healthy cardiomyocyte	eccentric hypertrophy	concentric hypertrophy
		
physiological loading	volume overload	pressure overload
healthy heart	ventricular dilation	wall thickening
		

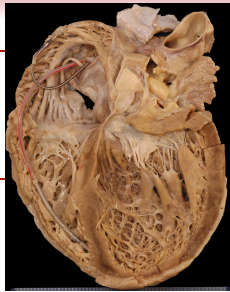
goktepe, abilez, kuhl [2010], goktepe, abilez, parker, kuhl [2010], rausch, dam goktepe, abilez, kuhl [2011]

can we predict eccentric and concentric growth?

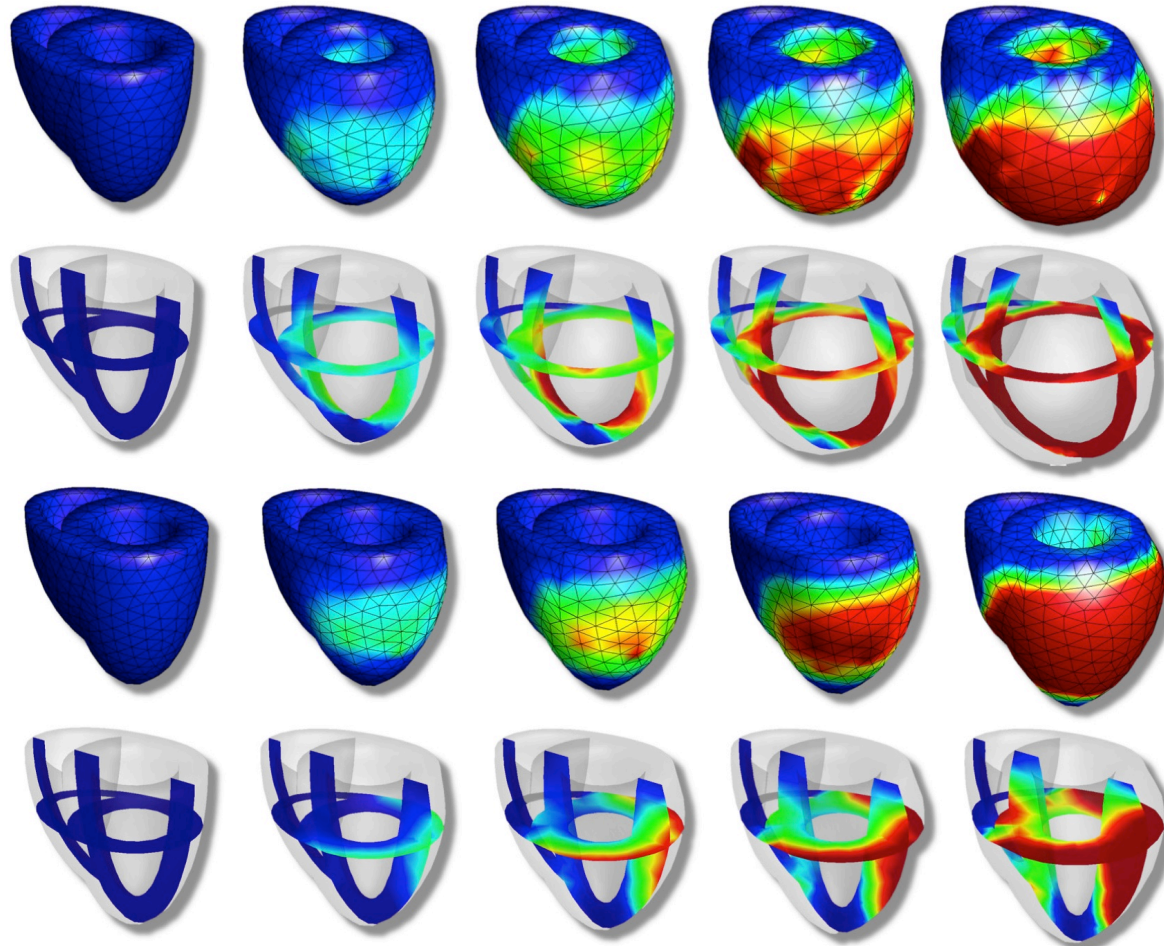
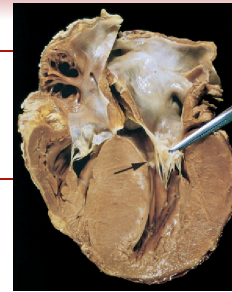


- chronic **chamber enlargement** vs **chronic wall thickening**
- cardiomyocytes **lengthen by 40%** at constant cell diameter
- cardiomyocytes **thicken by 150%** at constant cell length

cardiac dilation vs wall thickening



eccentric vs concentric growth



goktepe, abilez, kuhl [2010]

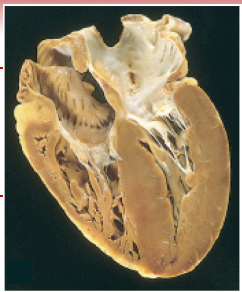
cardiac dilation vs wall thickening

can we predict left and right concentric growth?

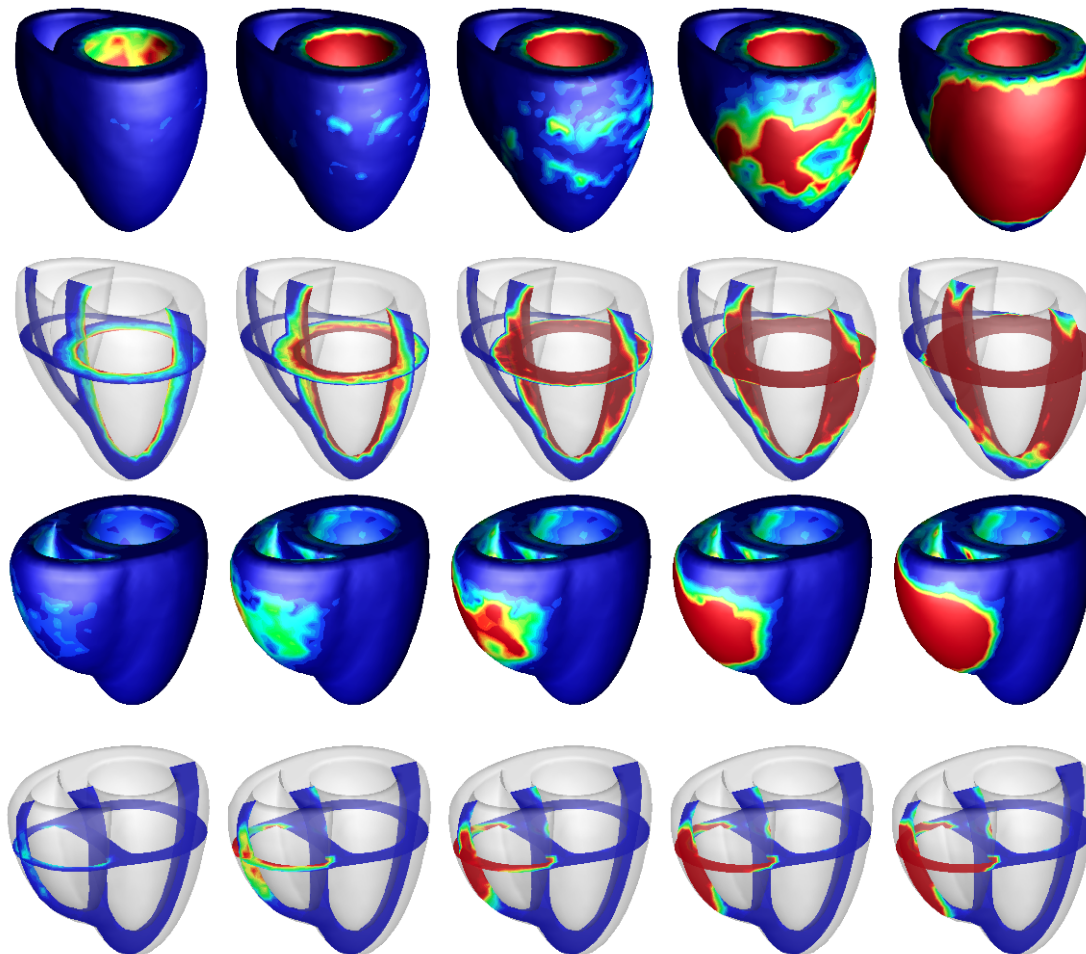
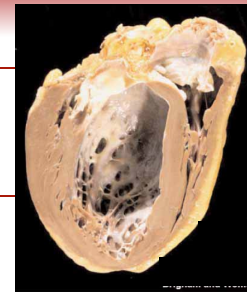


- chronic left and right **enlargement** and **wall thickening**
- wall thickening from **1cm to 3cm** and from **0.4cm to 1.2cm**
- cardiomyocytes **thicken by 150%** at constant cell length

systemic vs pulmonary hypertension



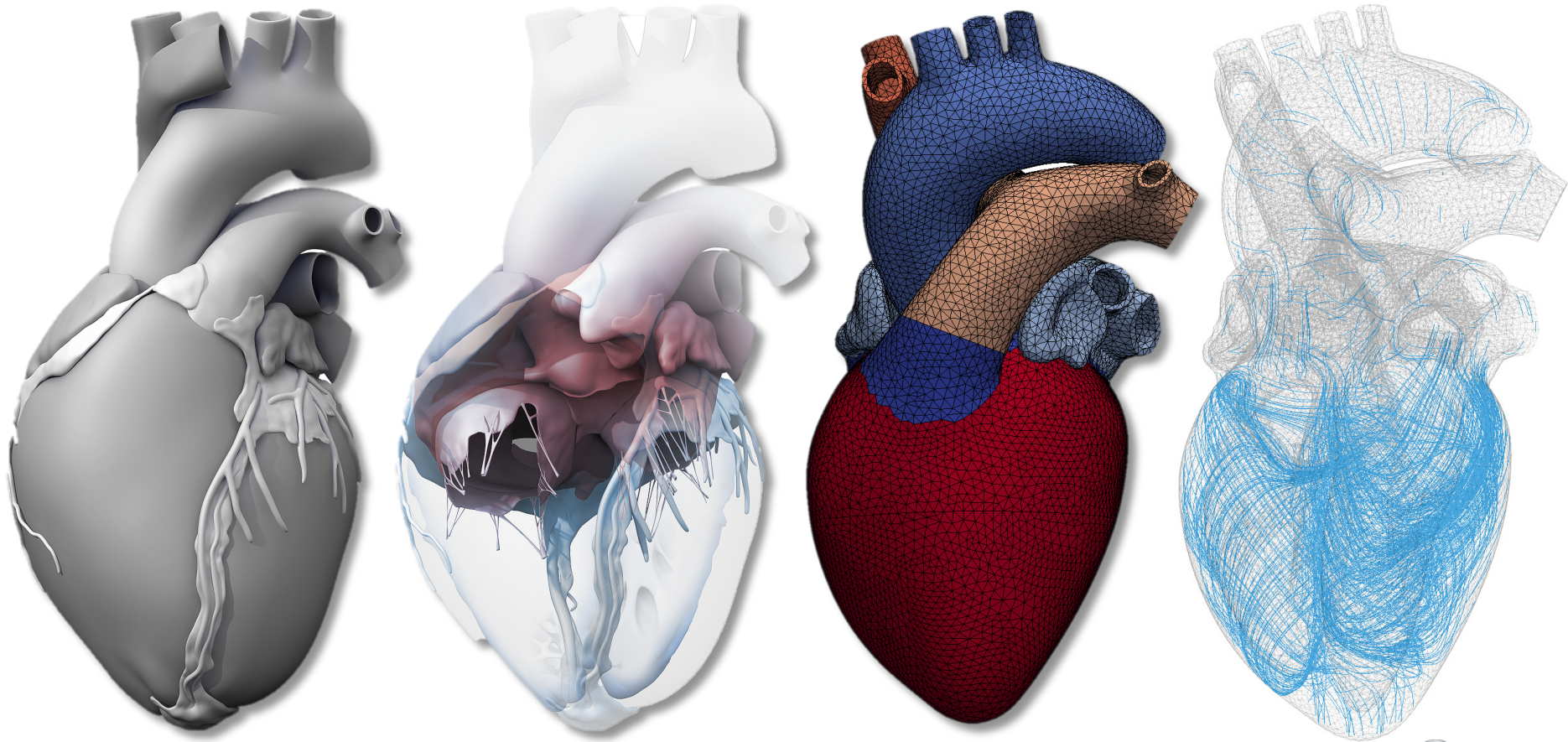
left and right concentric growth



rausch, dam, goktepe, abilez, kuhl [2011]

systemic vs pulmonary hypertension

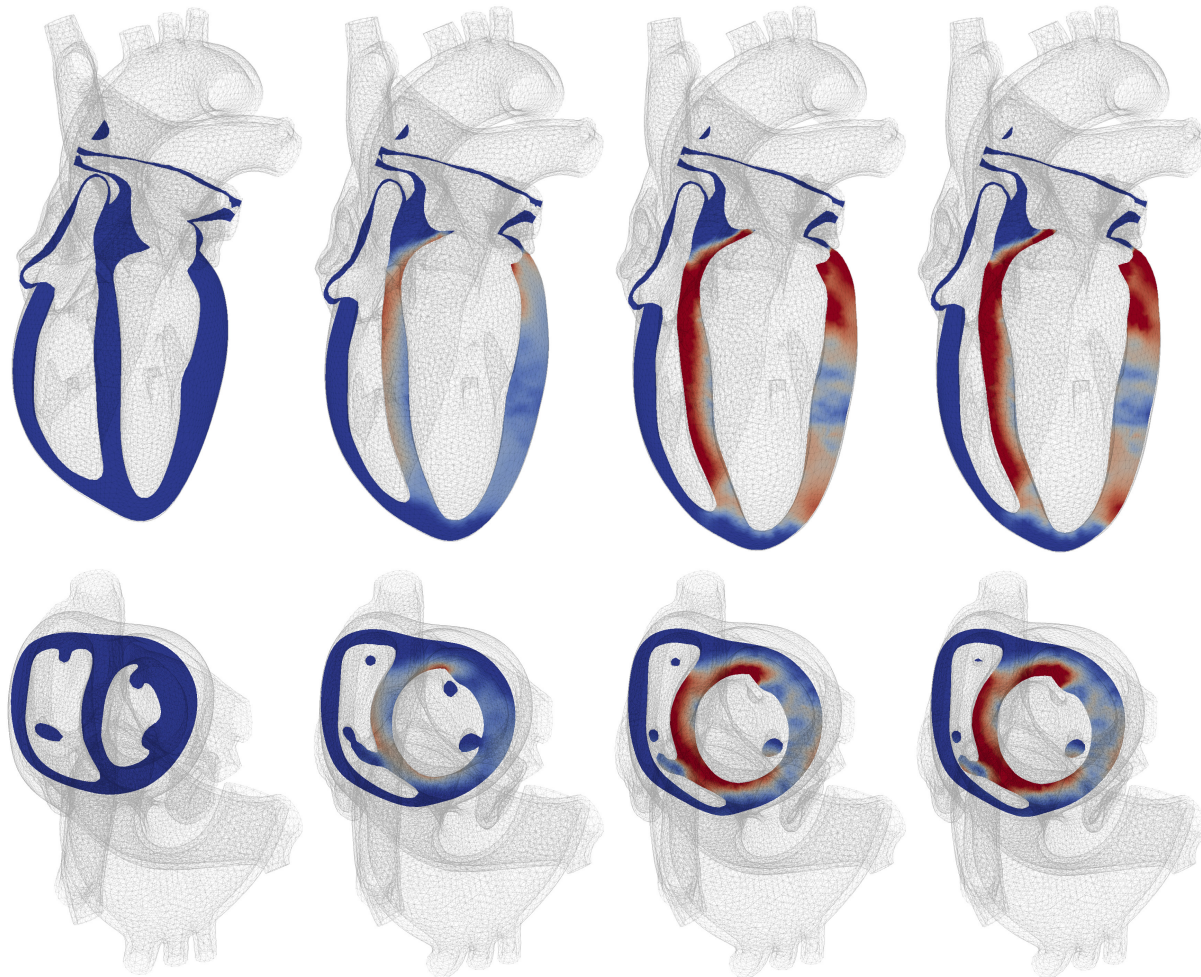
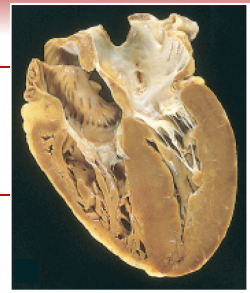
can we predict growth within the living heart project?



zygote media group and inc. [2013]; baillargeon, rebelo, fox, taylor, kuhl [2014]



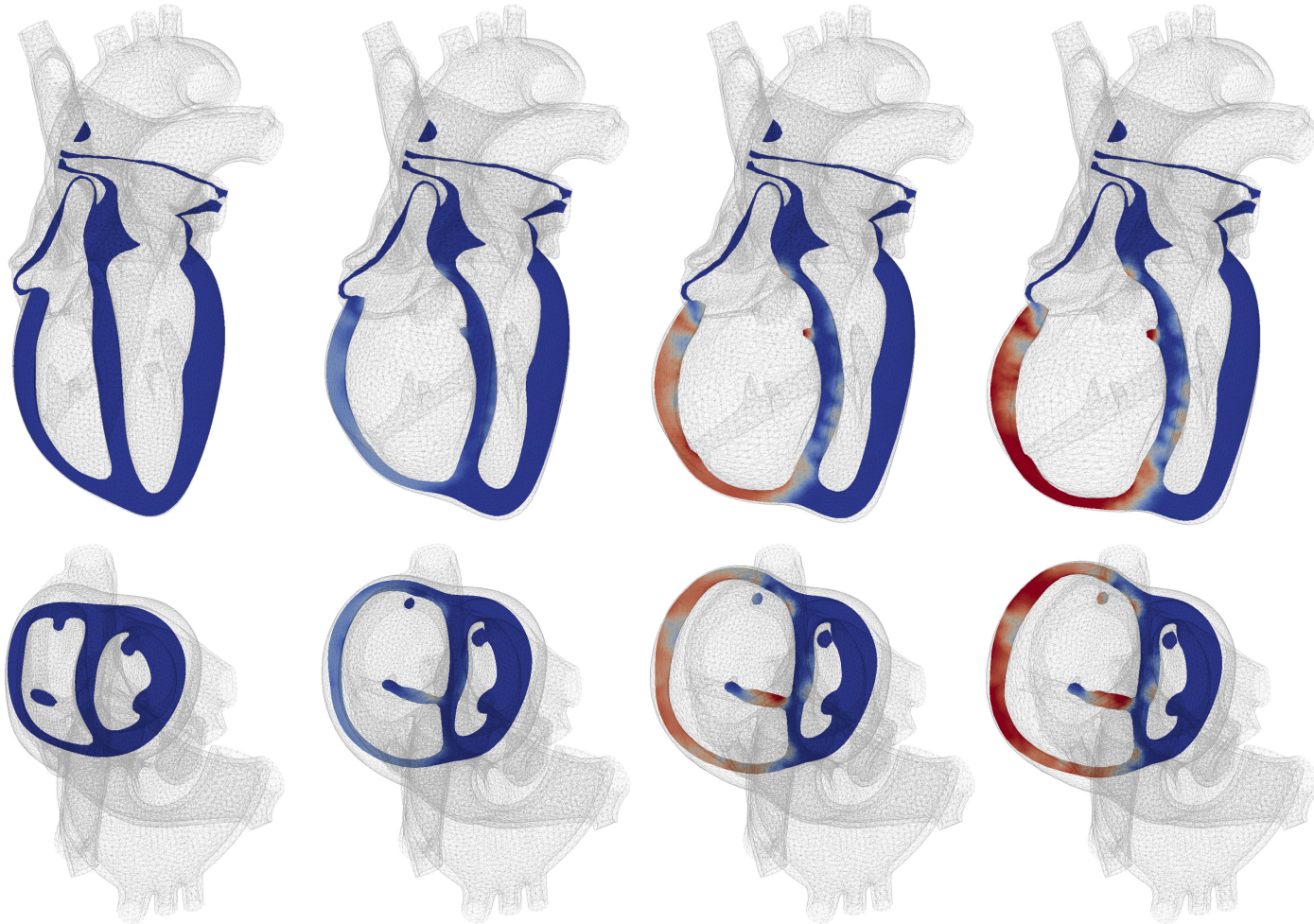
left concentric growth



genet, toutain, lee, baillargeon, guccione, kuhl [2014]

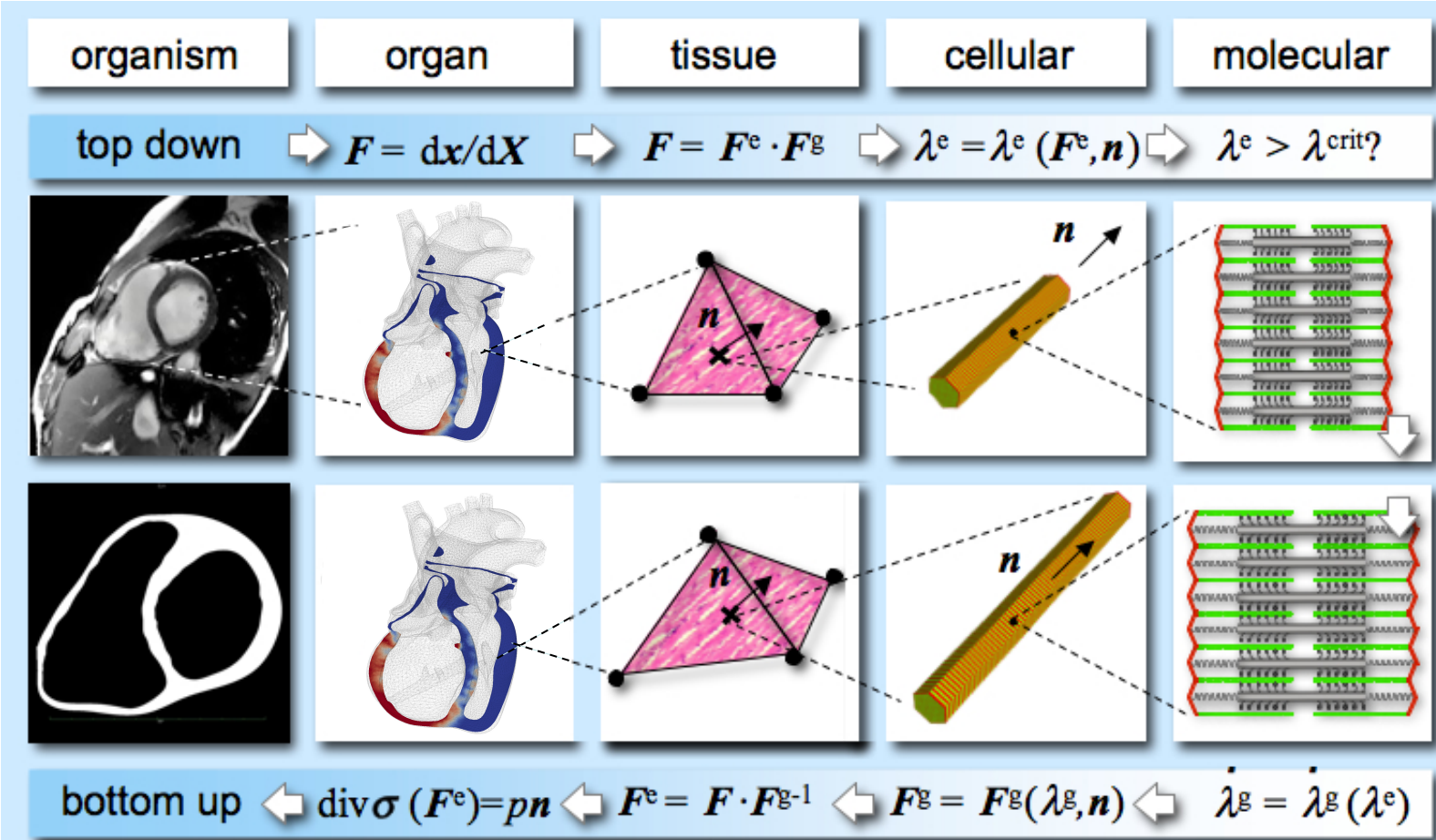


right concentric growth



genet, toutain, lee, baillargeon, guccione, kuhl [2014]

what's next? can we validate the model across the scales?



NIH U01HL119578 'multi-scale laws of myocardial growth and remodeling' guccione, kassab, kuhl [2014-19]

modeling pathologies within the living heart project