Abstract

Significant work has already been done to treat and alleviate Obstructive Sleep Apnea Syndrome (OSAS) – an anatomical, physiological, and neurological disorder that causes the collapse of the Upper Airway (UA) during sleep. But invasive techniques and the risks of long term radiation exposure limit the amount of medical data available in order to advance treatments.

Fluid-Structure Interaction (FSI) models of the UA have the potential to provide much needed information on the internal mechanisms at work during OSAS episodes. This thesis studies the simulation methods used to model OSAS in order to assure that information provided to medical professionals is both anatomically and physiologically relevant. Three components of OSAS are explored – the UA wall lining, the air that flows through the UA, and the interaction between the two. Numerous computational models and case studies are compared in order to verify results with published data.

Using ANSYS® Fluent and APDL, it was determined that a transition-turbulence flow model is significantly better at accurately modeling published data than the more commonly used RANS turbulence models. It was also determined that while a hyperelastic solid model is more appropriate for studying the UA, a linear model with large deformation enabled is a viable structural model to study OSAS with. Finally, it was also confirmed that the significant change of the flow field during two-way FSI coupling leads to vast differences between flowrate through fixed walls vs. a flexible walls.

The findings of this study serve to make FSI studies of the UA more accurate and verifiable.