

**Thomas Heldt**

**Cardiovascular-Respiratory System Modeling and Applications.**

**The topics covered are as follows:**

1. Modeling the peripheral circulation (2 units). Taking a Guytonian viewpoint, I will introduce the concept of the venous return curve and how its shape can be modeled with a simple lumped-parameter model of the peripheral circulation. Particular attention will be paid to the concept of a Starling resistor to model the plateau of the venous return curve at low filling pressures. (2 units).
2. Modeling the heart-lung pumping unit. Similar to the above, I take again a Guytonian viewpoint to introduce the concept of the cardiac output curve. Particular attention will be paid to the non-linear nature of the pulmonary vasculature, the end-diastolic pressure-volume limit of the right and the left ventricles, and the fact that under normal circumstances, cardiac output is limited by the right heart. (2 units)
3. Modeling the short-term cardiovascular control mechanisms. Particular attention will be paid to modeling the action of the sympathetic and parasympathetic control of heart rate, vascular resistance, venous tone, and cardiac contractility. I will review the basic physiology of autonomic control and the time delays involved. I will also touch upon various implementations of these reflex mechanisms. (2 units)
4. Putting everything together. In the final two units allocated to me, I will give a survey of different types of models and control system implementations, their purposes, applications, pitfalls, and strengths.