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Computational Model of Human Cardiopulmonary System

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Abstract : The cardiopulmonary system is comprised of the heart, lungs, and many dynamic feedback mechanisms that control its function based on a multitude of variables. The next generation of cardiopulmonary medical devices will involve adaptive control and smart pacing techniques. However, testing these smart devices on living systems may be unethical and exceedingly expensive. As a solution, a comprehensive computational model of the cardiopulmonary system was implemented in Simulink. The model contains over 240 state variables and over 100 equations previously described in a series of published articles. Simulink was chosen because of its ease of introducing machine learning elements. Initial results indicate that physiologically correct waveforms of pressures and volumes were obtained in the simulation. With the development of a comprehensive computational model, we hope to pioneer the future of predictive medicine by applying our research towards the initial stages of smart devices. After validation, we will introduce and train reinforcement learning agents using the cardiopulmonary model to assist in adaptive control system design. With our cardiopulmonary model, we will accelerate the design and testing of smart and adaptive medical devices to better serve those with cardiovascular disease.

Keywords : adaptive control, cardiopulmonary, computational model, machine learning, predictive medicine
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