

# HOW THE HEART MUST WORK WHEN IT FILLS

or

## How Kinematic Modeling Can Elucidate Physiology

### **Abstract:**

The mechanism by which the heart fills with blood (diastolic function) has remained a topic of permanent controversy since William Harvey (1628) characterized the circulatory system. Because technology (echocardiography, MRI, CT, electronic catheters) allows superb data acquisition of anatomy, structure, motion and hemodynamics – new insights into filling can be achieved by application of engineering principles (Newton’s laws, volume conservation, incompressibility, causality, ...). I will describe selected aspects of how the heart works from the perspective of a cardiologist/physiologist – and then show that by invoking basic engineering and physical principles, selected aspects of diastolic function become apparent. The ability of kinematic modeling to explain previously observed – but heretofore unexplained – physiology, and even to predict ‘new’ physiology will be included. Some clinical examples will highlight its translational potential in the real world of cardiology.

### **Mini-Bio.**

Prof Kovács received his undergraduate education in engineering at Cornell and did his graduate studies at Caltech. His PhD was in theoretical physics (*‘Generation of Gravitational Waves’* – Kip Thorne, Advisor). In part influenced by the work by George Zweig (Caltech, quark model co-inventor) in cochlear mechanics/wavelets, and application of mathematical physics/engineering to physiology/biology, he obtained his MD from U of Miami, PhD to MD Program. Training in internal medicine and cardiology at Washington University in St Louis followed. He is board certified in internal medicine and cardiology, and is an ‘invasive’ cardiologist. He was one of the originators of Washington University’s Dept of Biomedical Engineering, and his student Andrew Hall was the first student to obtain a DSc in BME from WU. He directs the Cardiovascular Biophysics Research Group, [<http://cbl1.wustl.edu>] has appointments in Internal Medicine, Physiology (DBBS), Biomedical Engineering and Physics. He is the new President (2006-2008) of the *Cardiovascular System Dynamics Society* [<http://www.ucalgary.ca/CSDS/index.htm>] an international group of mathematically oriented cardiologists/physiologists.