Quantitative Image Analysis and 3-D Digital Reconstruction of the Right Coronary Aortic Valve Leaflet

Chi Zheng[1,2], John A. Stella[3], and Michael S. Sacks[3]
[1]Bioengineering and Bioinformatics Summer Institute, Department of Computational Biology, University of Pittsburgh, Pittsburgh, PA 15261
[2]School of Medicine, University of Pittsburgh, Pittsburgh, PA 15261
[3]Department of Bioengineering, University of Pittsburgh, Pittsburgh, PA 15261

Of the four human heart valves, the aortic valve is the one that is most often replaced. Current efforts in tissue engineering center on designing a viable replacement valve as an alternative to the existing non-viable mechanical and biological prosthetics. Compared with existing prosthetics, this valve would offer better longevity and biocompatibility. To design and construct such a valve, a detailed understanding of the microstructure of the native porcine valve must first be acquired. Histological sections of the right coronary leaflet of the aortic valve, taken along the circumferential direction, were first digitally imaged using bright field microscopy. Then, the slides were scanned individually and digitally stacked to construct a 3-D volumetric rending of the entire leaflet. The results of these imaging techniques will allow researchers to visualize local variations within the leaflet in terms of cell count, cellular layer thickness, and structural protein composition. An inferred understanding of the function behind the structure will help researchers emulate the performance of the aortic valve in the tissue-engineered prosthetics.