Arterial flow characterization with a photodiode array based imaging system

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(Received 17 August 1988; accepted for publication 4 January 1989)

An x-ray imaging system is described that can be used for obtaining arterial blood flow information. The system consists of a linear photodiode array image detector, simple optical and mechanical components, and a data acquisition microcomputer that connect to a conventional x-ray image intensifier based fluorography system. Flow information is obtained by detecting the movement of a small, locally injected bolus of radio-opaque contrast agent. This is done by determining the bolus mass, integrated over the cross-sectional area, at each of 1024 positions along the length of the artery with a sampling rate of up to 200 samples per s. It is shown in a phantom study that the peak flow velocity can be measured with an accuracy of ±5% by detecting the bolus arrival times at each of the 1024 positions. The mean velocity is obtained with similar accuracy using a cross-correlation technique and a modified form of the Stewart–Hamilton principle. In addition, it is shown that the separation and reattachment points resulting from flow separation near a stenosis can be determined from the bolus clearance times. The locations of these points are consistent with theoretical values for the cosine shaped symmetric 89% stenosis used in this study.

**Indexing Terms:** Digital Systems, Biomedical Radiography, Blood Flow, X-Ray Radiography, Image Processing, Arteriosclerosis, Flow Rate, Iodine, Phantoms, Heart