

# **Coronary blood flow measurement using digital subtraction angiography and first pass distribution analysis**

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Due to the well-documented problems associated with visually interpreting coronary angiograms, other, more physiologic, means of assessing coronary artery stenosis are being investigated. One parameter which has been suggested is coronary flow reserve (CFR). A digital subtraction angiographic (DSA) technique known as parametric flow imaging (PI) has been studied in our laboratory, and has been proposed as a means of measuring CFR. This PI technique is capable of measuring only relative coronary flow (CF) rates however, and therefore cannot detect complicating factors such as elevated baseline CF.

The present study proposes another DSA method for measuring both CFR and absolute CF. This technique is based on first pass distribution analysis (FPA) and should have several advantages over PI, in addition to its' absolute flow measurement capability. These advantages include a more sound theoretical foundation, a greater immunity to noise and misregistration artifacts, the requirement of less-critical operator intervention, the capability of measuring CF in nonhomogeneous perfusion beds, the possibility of measuring phasic CF patterns, and compatibility with the motion-insensitive dual-energy DSA technique.

This dissertation begins with a discussion of the significance and limitations of CFR, and then details the PI method of measuring CFR. The theory and experimental implementation of FPA are then discussed. A specific FPA algorithm is used to explore the feasibility of the FPA technique by studying flow through a phantom, and through the canine circumflex artery.

It was determined that FPA is capable of measuring CFR with a greater precision than PI, and that accurate, absolute flow measurements may be obtained, though not always in the straightforward way prescribed by the FPA algorithm. This difficulty is attributed to the effects of temporal lag, and would likely be corrected through the use of improved cameras. The feasibility of the general FPA method is thus established. Extended applications of FPA are also discussed, including the implementation of FPA with dual-energy DSA techniques and the use of FPA for measuring phasic CF.