X-ray and Magnetic Resonance Imaging (MRI) Fusion to Guide Clinical Revascularization of Peripheral Chronic Total Occlusions (CTOs)

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Abstract

Percutaneous transluminal angioplasty (PTA) is a minimally invasive procedure used to revascularize blocked arteries of the heart and peripheries. However, endovascular approaches to treat chronic total occlusions (CTOs) of the superficial femoral artery (SFA) have proven challenging due to the presence of long and multiple occlusions, which cannot be visualized under x-ray fluoroscopy (XRF) alone. Devices can exit the artery leading to severe perforation. Magnetic resonance imaging (MRI) can produce three-dimensional vascular maps that are sufficient to identify the lesion extent and characterize the surrounding vasculature. Higher PTA success rates could be achieved for lengthy occlusions by merging 3D MRI data and XRF. This thesis develops a 3D MRI to 2D XRF registration method to guide revascularization of peripheral CTOs. The registration method utilizes bones in the MR and x-ray images as landmarks for registration. Furthermore, using an edge-based similarity measure the algorithm automatically maintains alignment together with C-arm tracking.