

# Quantification of Arterial Electromagnetic Properties for Peripheral Artery Disease Screening

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**Abstract:** Peripheral artery disease (PAD) is a slowly progressive vascular disease characterized by abnormal narrowing of peripheral arteries through atherosclerosis. PAD often goes unnoticed and is heavily underdiagnosed due to its initially asymptomatic features and if not detected early enough can lead to critical limb ischemia or limb amputation. Current PAD screening options are limited to the clinical setting and require specialized equipment, specialized training in operation, specialized training for interpretation of the results, and lack the ability to screen for PAD in a simple, cost effective point-of-care manner. In this study, our objective was to create a novel, non-invasive, point-of-care screening patch for the early detection of PAD. To attain our objective, we tested our hypothesis that electromagnetic changes in the permittivity and permeability of blood can be used to detect blood-flow abnormalities of PAD with a simple wireless biosensor – applied like a small adhesive bandage. When activated by an external RF wave, the skin patch developed an electromagnetic field that penetrates into its surroundings. Using a Vector Network Analyzer (VNA), we were able to quantify the skin patch's electromagnetic field interactions with its surroundings. Using a human arm phantom with vascular network, synthetic blood, and heart pump the skin patch was able to measure pulsatile blood flow as shifts in the sensor's resonant frequency. The results were validated using an ultrasound pulse wave Doppler which detected 50 bpm on the arm phantom. The smart skin patch was able to detect pulsatile flow with 100% accuracy when compared to ultrasound. These results strongly suggest that the patch may be capable of measuring pulsating blood-flow in a point-of-care fashion which does not require specialized training or expensive equipment. What's more, is that this biosensor does not have batteries, no electrical components, and has wireless communication.