Myocardial ischemia is set of symptoms associated with an imbalance between blood supply and demand to the heart. If the blood supply to the heart is acutely reduced, perhaps due to blockage of the coronary arteries (atherosclerosis), ischemia can arise even at normal physiological heart rates. Alternately, if heart rate increases, perhaps due to increased physiological stress (exercise) and there exists a chronic limitation in blood supply, the resulting increased metabolic demand may also result in ischemia. Thus the settings of acutely reduced blood supply or acutely increased metabolic demand represent two different but potentially overlapping pathways that can each induce ischemia. Myocardial ischemia results in impaired functioning of the heart, which, if untreated, can lead to myocardial infarction (heart attack) and cell death. Therefore, early detection of ischemia is critical, especially in patients with coronary artery disease (CAD).

The electrocardiogram (ECG), which is a record of the electrical activity of the heart, remains the most commonly used diagnostic tool for ischemia. In particular, shifts of the ST segment of the ECG are specific markers for ischemia, however, interpretation of ST segments is often equivocal. Our research is focused on reducing ambiguity of ECG based detection of ischemia by characterizing the spatial and temporal details of electrical activity of the heart during ischemic episodes. Our studies with animal models suggest that myocardial ischemia has a more complex and heterogeneous spatiotemporal distribution than documented in the past. This new description of bioelectric fields during ischemia drives associated simulation research and promises improvements in sensitivity and specificity of ECG based diagnosis of myocardial ischemia.

The role of the CIBC in this research is essential through the creation and support of image processing, image based modeling, and visualization tools.