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# MEANDERING OF SPIRAL WAVES IN ANISOTROPIC TISSUE

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**Abstract.** We present some new results on spiral wave meandering in anisotropic cardiac tissue. We compare numerical simulations of the bidomain model of cardiac electrical activity to theoretical predictions derived from a mathematical analysis of rotational symmetry-breaking for Euclidean equivariant dynamical systems.
**Keywords.** cardiac, anisotropy, bidomain, spiral wave, meander

## 1 Introduction

Cardiac arrhythmias are often caused by spiral waves of electrical activity [1]. The tip of a spiral wave is not always stationary, but may meander through the heart in a pattern resembling an epicycloid [2]. This motion is characterized by two frequencies: a frequency $f_1$ of the spiral wave rotation, and a meander frequency $f_2$.

Cardiac tissue is anisotropic [3], and this anisotropy modifies how the tip of a spiral wave meanders. Numerical simulations by Roth [4, 5] indicate that in some cases anisotropy causes the meander pattern to drift linearly in space, and in other cases anisotropy results in a locking of the rotation and meander frequencies.

Recent mathematical analyses by LeBlanc and Wulff [6] and LeBlanc [7] have resulted in a description and classification of the generic effects of breaking translational or rotational symmetry for Euclidean equivariant dynamical systems. These theoretical results explain how boundaries and inhomogeneities (breaking of translational symmetry), or anisotropy (breaking of rotational symmetry) modify spiral wave dynamics. In particular, analysis of rotational symmetry-breaking [7] predicts under what conditions drifting and frequency locking occur for spiral waves in anisotropic cardiac tissue. If the ratio $f_1 : f_2$ is equivalent to the ratio of two small integers $m : n$, then $m + n$ even results in frequency locking, whereas $m + n$ odd leads to