**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI**
**SHORT ABSTRACT OF THESIS**

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**SHORT ABSTRACT**

Over the past few decades, spirals have attracted a lot of interest. From a spinning galaxy to a swarm of honeybees, rotating spirals are widespread in nature. Their widespread presence in nature has made the study of spiral waves relevant across various disciplines. In physical systems like fluid flows, liquid crystals, galactic formations, etc., in biological systems like the heart, chicken retina, neocortex, slime mould, etc., in chemical systems like the Belousov-Zhabotinsky (BZ) reaction system, the Briggs-Rauscher reaction, some simple precipitation processes, the oxidation of CO on platinum surfaces, etc., scientists have observed and studied spiral waves. Despite these studies, the ambiguity of spiral waves has prevented scientists from developing a comprehensive hypothesis.

The disruption of the heart's regular rhythm by spiral wave activity can lead to the development of heart disorders such as atrial and ventricular tachycardia and cardiac fibrillation. It also has a role to play in epilepsy. Therefore, spiral wave dynamics are of great interest to the scientific community, particularly its interaction dynamics and control. Even though we have some literature available on spiral wave interaction and control, there are many aspects yet to be explored.

Our study mainly addresses the issue of spiral wave interaction. When two spiral waves are close, they interact either by annihilating or pushing one another away. These spiral waves may become pinned when they encounter unexcitable heterogeneity. The anchoring of spiral waves with inert, heterogeneous anomalies is observed in the heart, which has a deteriorating effect. The essential characteristics of a spiral wave, such as its rotating frequency, time period, etc., are modified by pinning. Finally, we have explored the interaction of two pinned spiral waves pinned to heterogeneities of different sizes. This study demonstrates how synchronisation results from such an interaction.

The BZ-reaction and cardiac tissue appear to be comparable in a number of important ways. The heart is an anisotropic medium that is highly discontinuous and inhomogeneous, in contrast to the BZ-reaction. However, the behavioural parallels between the two systems are so striking that BZ has become one of the best mimic systems to study spiral wave activity among scientists. We carried out our studies using thin layers of the ferroin-catalyzed BZ-reaction embedded in gel layers with malonic acid as the organic substrate. We employed the two-variable Barkley model of reaction diffusion equations for the theoretical analysis.