# Localization and numerical evaluation of myocardial fibrillation by mathematical image processing methods

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2023

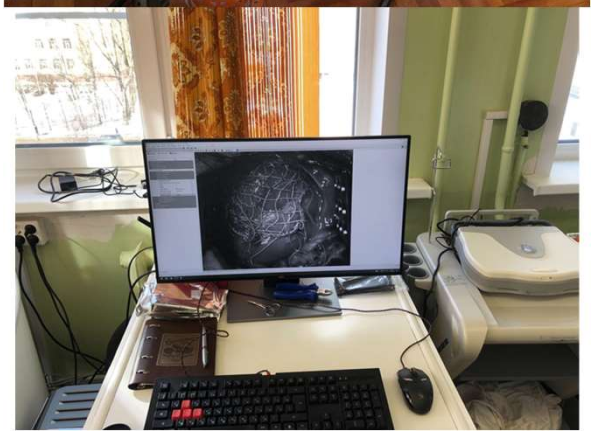
# Aim

The study of spiral waves is very important for obtaining fundamental knowledge about the nature of arrhythmogenic processes.

One of the possible ways to obtain the appearance of a spiral wave is to read the mechanical phenomena of the cardiac tissue surfaces, which are able to express the manifestations of vortex phenomena due to mechano-electrical feedback.

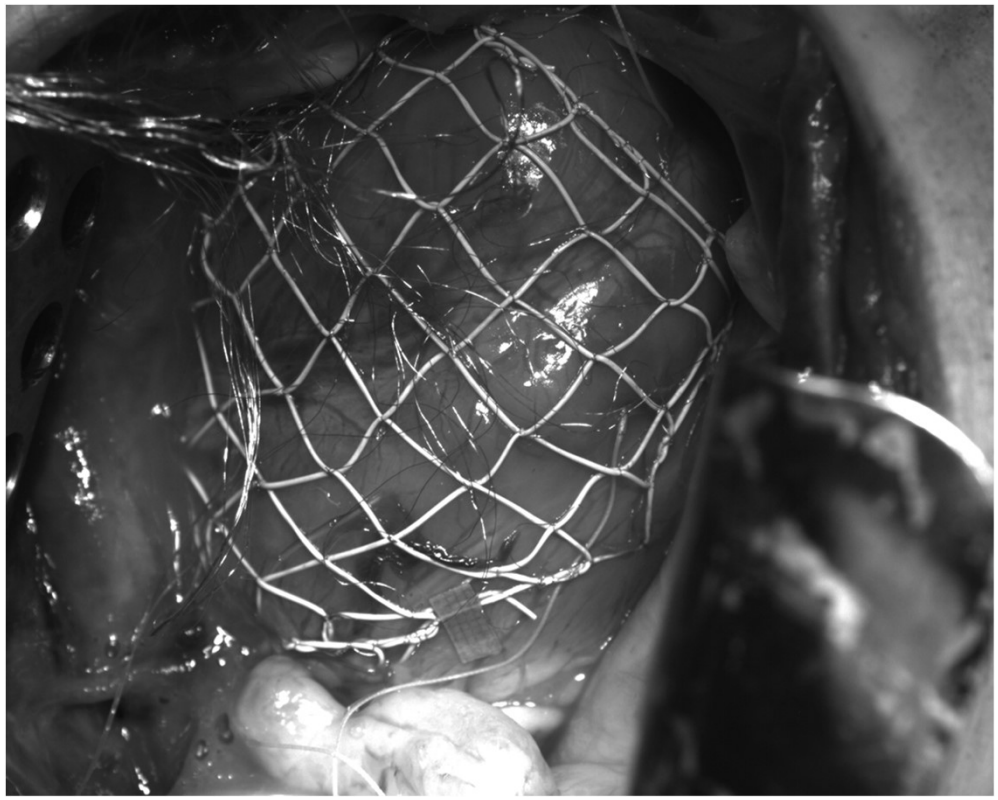
A high-frequency camera and deep learning methods were used to study changes in the deformation of normal and ischemic heart tissue.

The visualization of these phenomena can contribute to a deeper understanding of arrhythmogenic processes and help in therapeutic purposes, as they play an important role in the development of fibrillation.



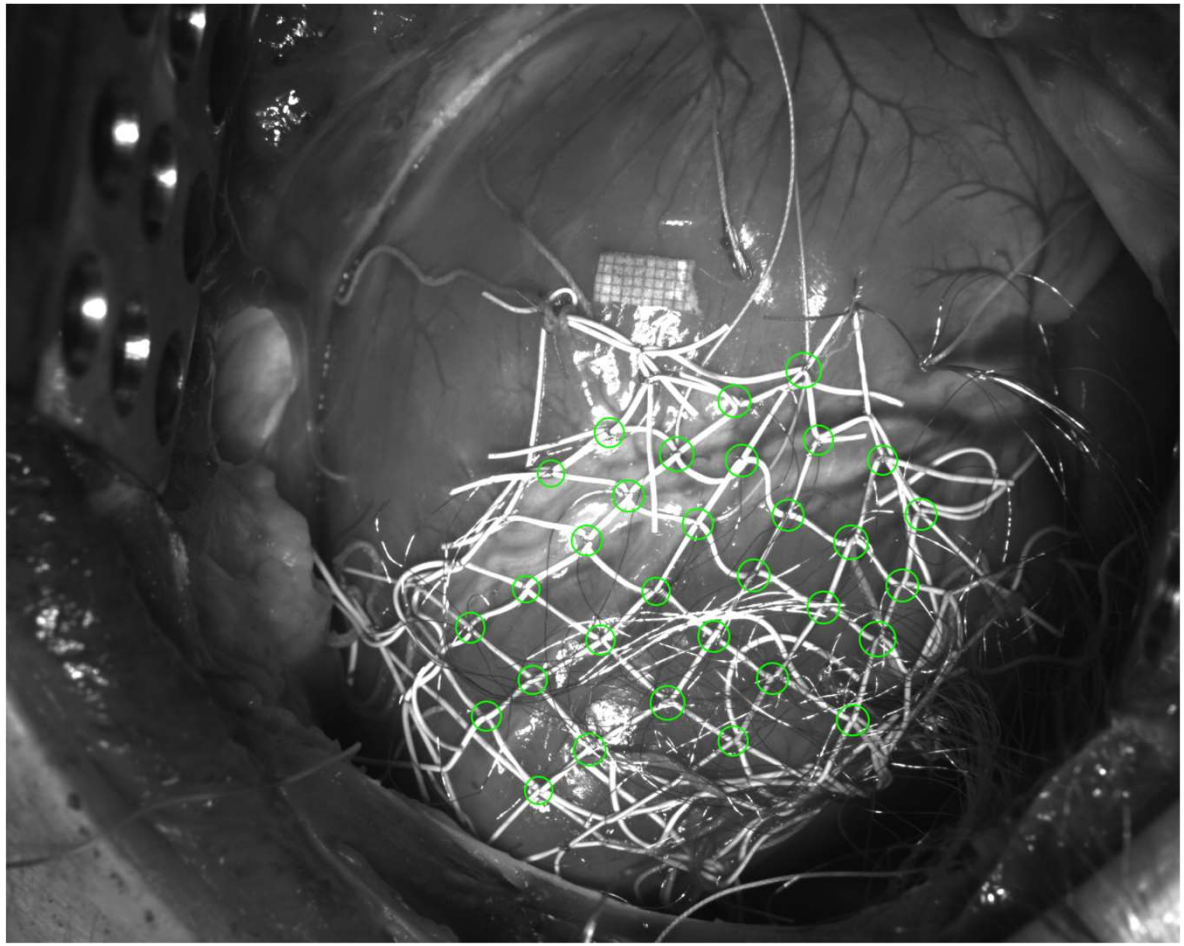
# Materials and Methods

Experiments performed on anesthetized pigs (body weight 30-45 kg). The heart was reached through a midline chest incision. Myocardial ischemia was caused by occlusion of the left anterior descending coronary artery during 40 min. Throughout the experiment, continuous recording of 3 leads of standard ECG monitoring was performed to control ECG parameters and evaluate the development of arrhythmias. The video recording of anterior wall motion of the heart was performed before coronary occlusion, within one minute after the start of ischemia, and every 5 minutes until the end of the 40-minute interval or onset of ventricular fibrillation. The data from the experiment was labeled and used as a training sample of data to train the neural network.

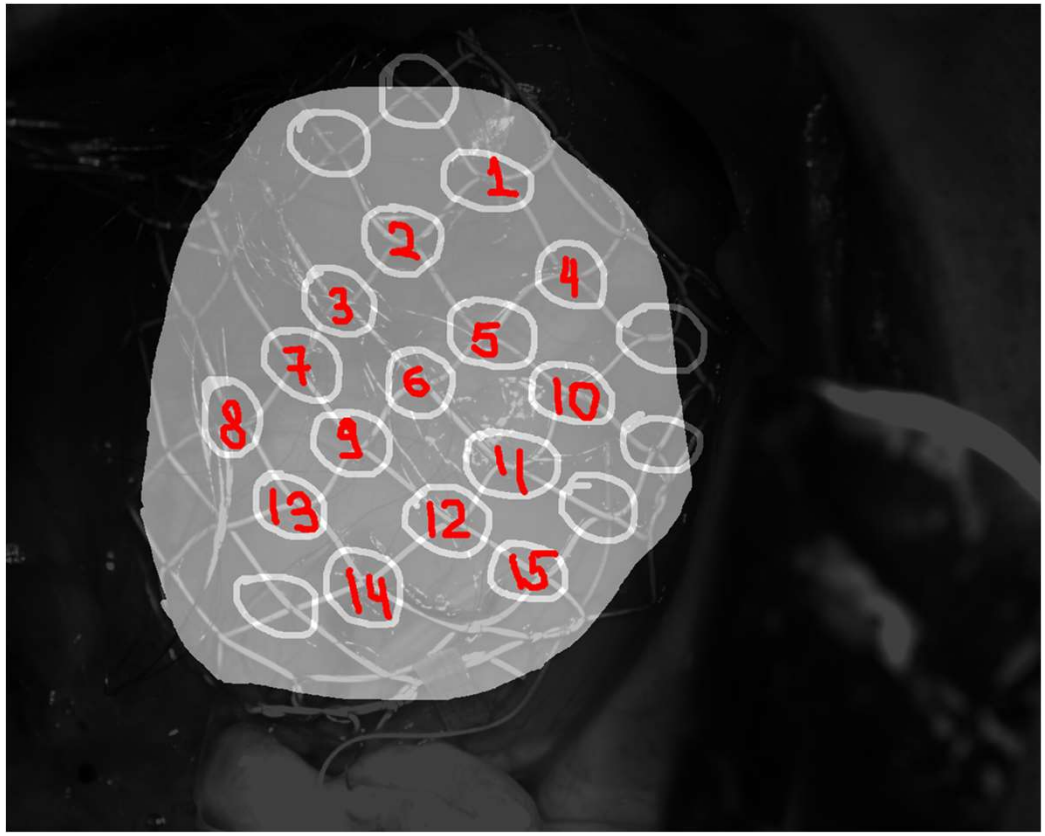


# Results

We present a technique for detecting cardiac surface electrodes using neural networks. Using the obtained data, point motion analysis is performed to localize and numerically estimate tissue twisting by means of the vortex processing technique for particle motion.



# Results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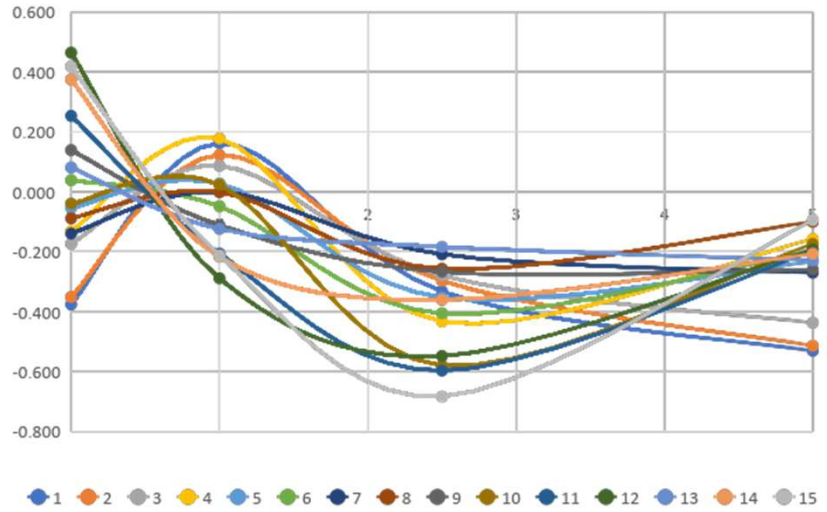
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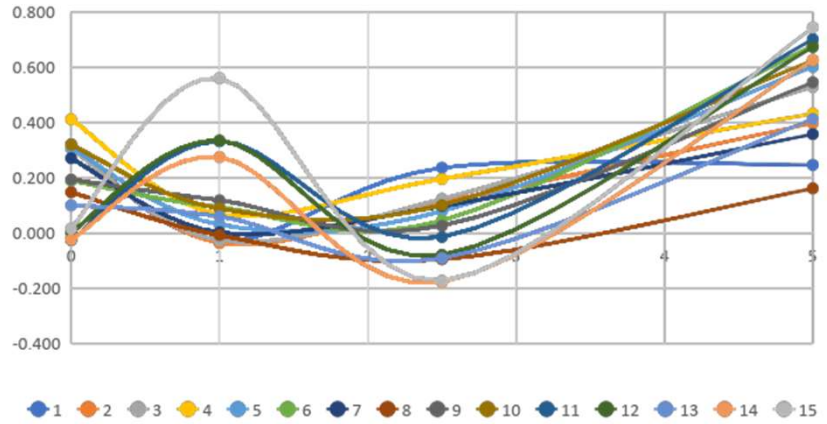
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# Conclusion

According to the data obtained, the presented algorithm can localize the arising fibrillation. In the future, to improve the localization accuracy, it is necessary to make changes in the program based on the ECG signal, which was obtained in the experiment.

After final testing and achievement of high accuracy of the algorithm, it will be necessary to make a user graphical interface for easy use of the program.

The obtained software product will allow to localize and numerically characterize fibrillation by heart video recording, which will contribute to solving the problem of researching the mechanisms of cardiac fibrillation and its treatment methods.