

# **Focal Atrial Tachycardia: Investigating the Correlation Between P-Wave Morphology and the Anatomic Site of Origin**

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Atrial arrhythmias including focal atrial tachycardia (FAT) are characterised by highly rapid and irregular heart rates, manifested by abnormal P-wave morphology. FAT occurs when atrial excitation is initiated from a region other than the cardiac pacemaker. Identifying tachycardia origin normally requires detailed mapping systems, which are often expensive and invasive. The forward problem solution can be used to establish an atlas between the origin of FAT and the body surface potential (BSP), and therefore provides the relationship between FAT origin and P-wave morphology (PWM). Kistler et al. (2006) devised a focus-location algorithm based on this relationship. The aim of this project is to develop a biophysically detailed model of the human atria and torso to assess Kistler's algorithm. A biophysically detailed 3D model of the human atria was developed. The geometry was based on the visible human dataset and contained distinct classifications for the left atrium, right atrium, Bachmann bundle, sinoatrial node, pectinate muscles, and the crista terminalis, and also included fibre orientation in the crista terminalis, pectinate muscles and Bachamann bundle. The electrical activity of atrial cells in these regions was described by modified Courtemanche et al. (1998) equations. The 3D atrial model was placed inside a 3D model of the human torso derived from CT images, which considered geometric representations for the lungs and blood masses in the atria and ventricles. The forward problem is solved by the boundary element method to extract the BSP. Various tachycardia origins were simulated and the resulting P-waves were analysed by the algorithm. Simulated PWM varied with tachycardia origin, and showed close agreement with the data of Kistler et al. (2006). The algorithm correctly identified the FAT origin in 88% of the cases. A further refinement to the algorithm to locate the origin within the crista terminalis was suggested.