Diametrical Property of Spiral Wave Frequency Effect in Atrial Fibrillation

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Abstract

Introduction: Prior results of rotor migration past electrodes did not exhibit frequency changes typical of classic Doppler effect (CDE) physics. Rotors exhibited fastest and slowest frequencies at either side when migrating past electrodes, not directly in front and behind as in CDE. A new spiral wave frequency effect (SFE) equation required derivation to more accurately predict WF frequency changes observed near moving spiral sources SSp. Methods and Results: Rotational and spiral math were developed. As a prerequisite to solve SFE equation, a wave source of a rotating linear ray (SR) was used to derive rotational frequency effect equation (RFE). WF strikes from SSp occurred when the spiral summation angle equaled LOS angle. SFE is analyzed by varying spiral size and distance from SSp. New RFE and SFE equations predict the diverging frequency changes (increasing and decreasing) that occur simultaneously on either side of a passing rotor. Conclusions: Frequency effects of moving SR and SSp exhibit 3 main differences compared to CDE: side-dependent frequency changes, strong-side unpaired WF strike, and reversal of activation sequence. These 3 differences are predicted by RFE and SFE equations and constitute the unique diametrical property of rotational waves and spinning bodies in motion. Moving bodies that spin, or moving sources of rotating WFs, result in observed frequency differences that are relative to side of observation. One can no longer assume that higher frequencies and lower frequencies observed, represent always an approaching and receding SR and SSp respectively, especially when observers are near to the source.

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