

# Three-dimensional Frequency Mapping from the Non-contact Unipolar Electrograms in Atrial Fibrillation

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Three-dimensional (3D) colour-coded mapping of dominant frequency (DF) from noncontact unipolar electrograms in real-time can serve as a tool for identifying potential AF drives allowing the analysis and identification of re-entrant circuits sustaining atrial fibrillation (AF). The aim of this study was to develop 3D DF mapping of the inner surface of the atrium with 2048 measurement points from noncontact unipolar electrograms.

**Methodology:** This study was performed in 2 of 4 patients (2 paroxysmal, 2 persistent) undergoing catheter ablation guided by noncontact mapping (Ensite 3000, NavX 6.0, St. Jude Medical). 3D reconstruction of each atrial chamber, 3D electro-anatomic mapping and DF maps (and movies of 3D distribution in AVI format) during ongoing AF were performed using Matlab (MathWorks Inc., USA). Spectral analysis allowed determination of DF at each of the 2048 points in 19.5-second long segments for each protocol (baseline, after each drug, and after ablation). DF was defined as the frequency with highest amplitude within the physiological relevant range (3 to 15 Hz) using 4-second long windows. The time-domain unipolar signals were sampled at 1200 Hz and spectral resolution was 0.29 Hz. QRS subtraction was used to remove ventricular influence. We show how the spatial distribution of DF changes with time, drugs (isoprenaline and atropine), before and after ablation and compare DF areas with ablation sites.

**Results:** The visual analysis of the temporal evolution of the 3D DF mapping in those 2048 points showed that DF evolves its size and position in time. In addition we confirmed the effect of drugs on DF. Isoprenaline: two wide bands with DFs in (7.6 Hz and 3.5 Hz) and atropine: a narrow band with DF in 6.4 Hz. The QRS subtraction was important to reduce the power in the range of frequencies between 9 and 25 Hz on the average spectrum.

