9. Summary

The reproducibility of manual and automatic generation of cardiac activation maps was assessed in a digital multi-channel mapping system (Hoeks, 1988), based on 36 electrogram files with sinus rhythm, epicardial pacing and monomorphic ventricular tachycardia from an animal model of canine chronic myocardial infarction. Each electrogram file contained 240 unipolar electrograms of 640 ms duration digitized at 8 bits and 1000 Hz.

In order to determine the best combination of parameters for *automatic* map generation by the mapping system's activation detection program, a new numerical optimization program called OPTIMAPS was developed by the author. Best performance of the activation detection program was assumed at the minimum error rate in respect to manually generated reference maps of the first beat in each of 6 electrogram files (2 with each rhythm), the error rate being defined as the quotient of the number of errors and the total number of electrograms. An error was counted if (1) no activation was detected in an electrogram with activation, (2) activation was detected in an electrogram without activation, or (3) the difference between activation times exceeded 5 ms. The error rate of 32.3 % of the original activation detection program was reduced to 6.2 % by (1) implementing a fixed slope threshold for all channels, (2) estimating slopes by the 3-point-Lagrange algorithm and (3) optimizing the parameters of the activation detection program by means of the numerical optimization program OPTIMAPS. On an independent test of the improved activation detection program against 30 manual maps (10 with each rhythm) by a single observer and 10 maps with ventricular tachycardia by 4 independent observers, the activation detection program acchieved mean error rates of 9.6 % (95-% confidence interval 8.9 % - 10.3 %) and 15.2 % (14.2 % - 17.2 %), respectively.

The reproducibility of *manual* map generation was assessed based on 30 electrogram files (10 with each rhythm). The mean error rate on repeated contextual interpretation of the electrograms (isochronal map observed during map generation) by the *same* observer was 9.1 % (95-% confidence interval 8.4 % – 9.8 %) and on repeated non-contextual interpretation (electrograms presented in random order) 9.0 % (8.3 % - 9.7 %), the mean error rates between each set of contextual and non-contextual interpretations being 7.8 % (7.2 % – 8.4 %) and 7.0 % (6.4 – 7.6 %) respectively. The mean error rate between contextual interpretations of the 10 files with ventricular tachycardia by 4 *different* observers was 11.6 % (10.4 % – 12.9 %). Thus, while the improved automatic activation detection program disagreed with manual interpretations of 9.6 % to 15.2 % of all electrograms, disagreeing interpretations of the same electrogram data on repeated manual examination occurred in 7.0 % to 11.6 % of all electrograms.

To further improve automatic activation detection in electrograms, numerical optimization programs such as OPTIMAPS can be powerful tools. Progress is however hindered by the lack of precise quantitative criteria for detecting activation in extracellular signals.