STEVI: a general ECG viewer with enhancements for STAFF ECGs

Arie C. Maan, PhD, Cees A. Swenne, PhD, Dept. of Cardiology, Leiden University Medical Center (LUMC), Leiden, The Netherlands

Abstract:
The STaff Ecg VIewer (STEVI) was developed to facilitate viewing of raw ECG signals from the STAFF III database as well as viewing filtered and/or baseline corrected ECG's derived from STAFF or other databases processed by the program BEATS.

Methods:
STEVI is written in the Matlab environment (The Mathworks, Natick, MA, USA). The program has been tested on the Macintosh OSX platform, Windows XP and Windows 7.
Signals in the original STAFF files (recordingname with extension .ECG) were stored as a 1000 Hz 16-bit signal at 0.625 microvolt/bit, processed ECG's (recordingname with extensions .BCG or .FCG) are stored as comma separated ASCII values (microvolts) at 500 Hz.
STEVI stores selected amplitudes as comma separated ASCII values in a file (recordingname with extension .amp) provided BEATS has been used to perform user supervised beat detection.
The program BEATS, in brief, performs baseline filtering, constructs a vector cardiogram, finds the steepest slope in the spatial velocity (the fiducial point) and determines in an interactive manner the time of occurrence of onset QRS, J point and maximal T wave which are stored in a separate file, recordingname with extension .ref.
STEVI uses the .ref file to find, in each lead, the maximal R and S amplitudes by searching in a window around the fiducial point (-20 ms through occurrence of the J-point), it looks up the amplitude at the previously determined J-point and it searches a window of 150 ms around the T wave for the largest absolute value.

Results:
STEVI now has the following features.
1) Signals are displayed in a 12x1, a 6x2 or a 4x3 format, i.e. number of signals x number of frames.
2) The limb leads can be displayed using the Cabrera or the classical sequence.
3) Unwanted (noisy) signals can be excluded.
4) If necessary, any sequence of leads can be displayed; a given lead can even be displayed at more than one location
5) 'Paper speed' can be set at 25 or 50 mm/s.
6) Two colors and 2 linewidths can be chosen.
7) In multiple frame display time can be continuous or synchronized within the frames.
8) Grids (1 mm, 5mm) can be displayed.
9) Positions and maximal amplitudes of R, S, T waves as well as the amplitude and position of the J point may be visualized if the recording has previously been analyzed using BEATS.

Discussion:
Currently the emphasis of STEVI is on the different display possibilities. It is optimized for displaying recordings of up to 30 minutes although recordings of any length can be viewed.
The calculation of amplitudes may be improved on since detection of the absence of either R or S waves is not yet implemented. Also a provision is being made where the user can accept or reject beats and/or can edit amplitudes.