TAMPERE UNIVERSITY OF TECHNOLOGY
Ragnar Granit Institute

71210 Bioelektroniikka - Bioelectromagnetism
Laskuharjoitus 6 – Exercise 6, 27.10.2004

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1. The body surface ECG is measured using e.g. 26 to 256 electrodes. Figure 1 represents voltages of a normal body surface ECG measured at the end of a QRS complex. What can you say about the nature of the source according to this map?

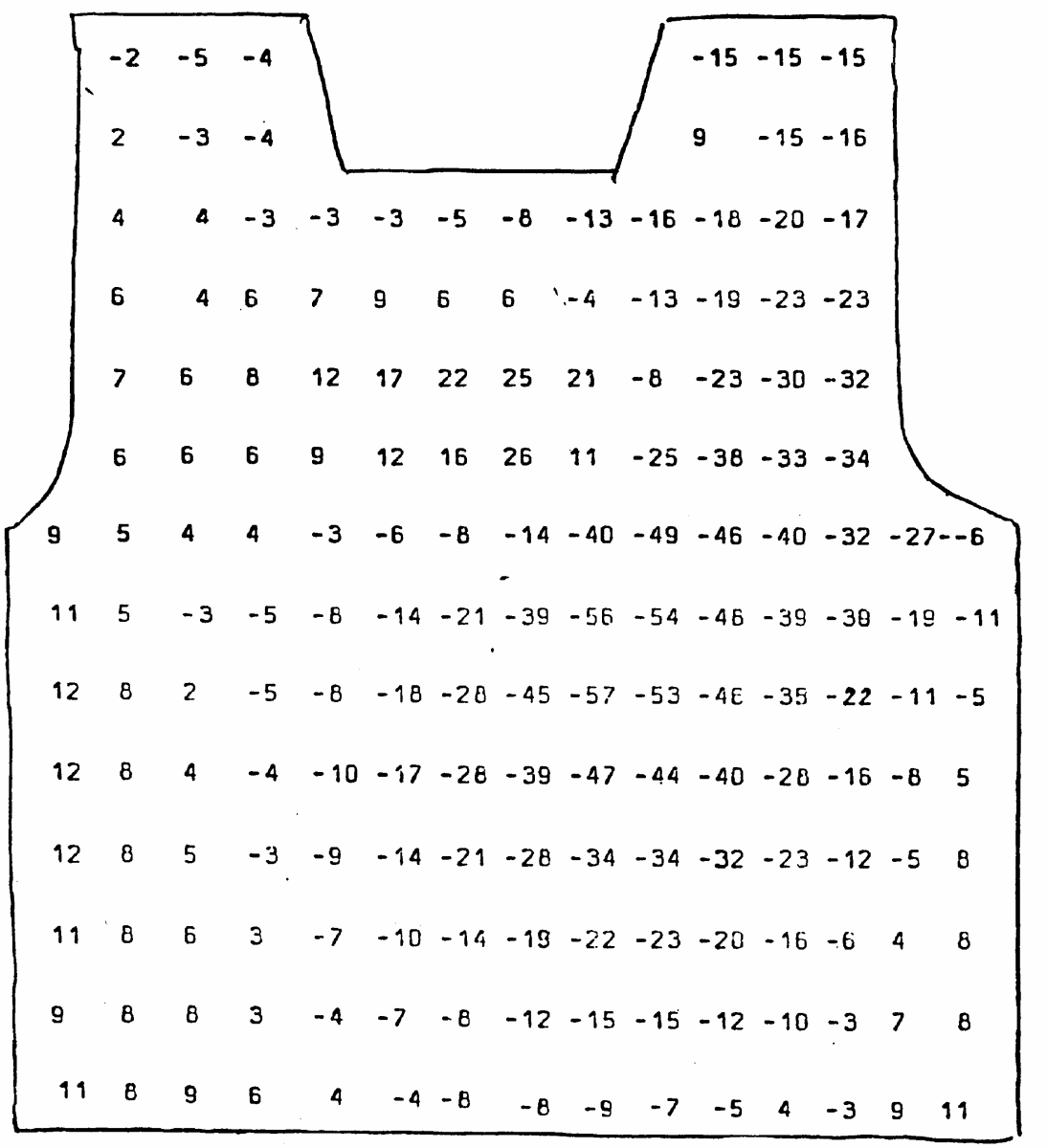
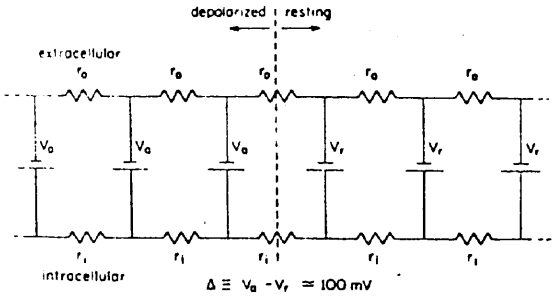


Figure 1. Anterior body surface map (BSM).

2. A patient has left bundle branch block (LBBB) 2 cm from the AV node. The activation continues over the damaged 0.5 cm long area in the myocardium. How long time will the action pulse need from the AV-node to the end of the 6 cm long bundle if the propagation velocities are 1.2 - 4 ms and 0.3 - 1 m/s in the bundle and in the myocardium respectively (worst case)? (*Answer: 15ms and 30,4ms*)

3. Figure 3 represents a model for calculating extracellular voltage drop across plane wave depolarization. Derive the equation for the potential across a plane depolarization wave using the model.



Model used for calculating extracellular voltage drop across a plane depolarization wave. The batteries represent the membrane potential. The values of r_i and r_e depend on the angle between the propagation direction and the fiber direction

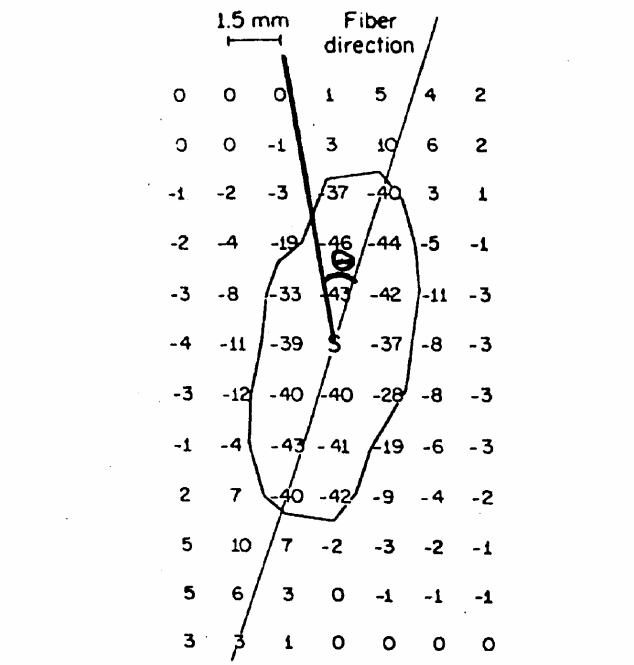
Figure 3 A model for calculating extracellular voltage drop across plane wave depolarization

4. Calculate the intra and extracellular resistances using the equation in the previous exercise, if V_{ot} = 16 mV and V_{ol} = 56 mV. Following equation also holds

$$\frac{v_t}{v_l} = \frac{\sqrt{r_{il} + r_{ol}}}{\sqrt{r_{it} + r_{ot}}}$$

Total resistances in longitudal and transversal directions to the fibers are 200 Ωcm and 630 Ωcm, respectively. (*Answer: r_{il}=357Ωcm, r_{it}=3938Ωcm, r_{ol}=455Ωcm, r_{ot}=750Ωcm*)

5. Figure 2 shows epicardial potentials measured 10 ms after stimulation. What are the propagation velocities in longitudal (= v_l) and transverse (= v_t) directions to the fiber orientation and the ratio of the velocities?



Kuva 3. ***Potential field (mV) 10 msec after stimulation. The depolarization wave has moved to the position shown by the heavy curve, which is the 10-msec isochrone in Figure 1. Note the asymmetry of the potentials outside the wavefront, the positive potentials ahead of the wave along the fiber direction, and the negative potentials in the transverse direction.***

Figure 2. Epicardial potential measured 10 ms after the stimulation