

Impedance maps of acupuncture points

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Aim

- Visualization of acupuncture points

Purpose

- Although application of acupuncture is relatively well established in Western medicine as a complementary therapeutic tool, its physical and medical characterization is still largely unknown.
- Several previous studies showed that acupuncture points may be characterized by lower electrical impedance and higher capacity.

Relevance

- Systematic review by Ahn et al. [1] concluded that it is still impossible to determine whether acupuncture structures possess distinct electrical characteristics until better quality studies are performed.
- Colbert [2] calls for precise replication of historical study of Becker et al. [3].
- Are very limited results of Becker et al. (1976) the corner stones of the whole (physical electro-) acupuncture research?

Methods and analysis

- Impedance maps were measured with a grid of 64 brass needle electrodes. Telescopic tips maintain balanced pressure across measured area covering 17.5 mm x 17.5 mm (Fig.1). Monopolar arrangement was applied with clamp reference electrode placed on the opposite arm (surface 6 cm²). Frequency 1 kHz was used for probing current. Unique recording system was controlled from Matlab environment via USB port. The device measured voltage difference between active and reference electrodes based on spike detector.
- Development of a new procedure that would enhance visualization of acupoints: We introduced concept of differential maps:
The experimental protocol includes impedance map measurements before, during, and after stimulation of acupuncture system. Then subtraction of maps obtained after and before stimulation is calculated. As one of the modalities, electro-acupuncture stimulation was used. Impact of different frequencies of stimulation will be further studied, also with regard to meridian excitation or inhibition.

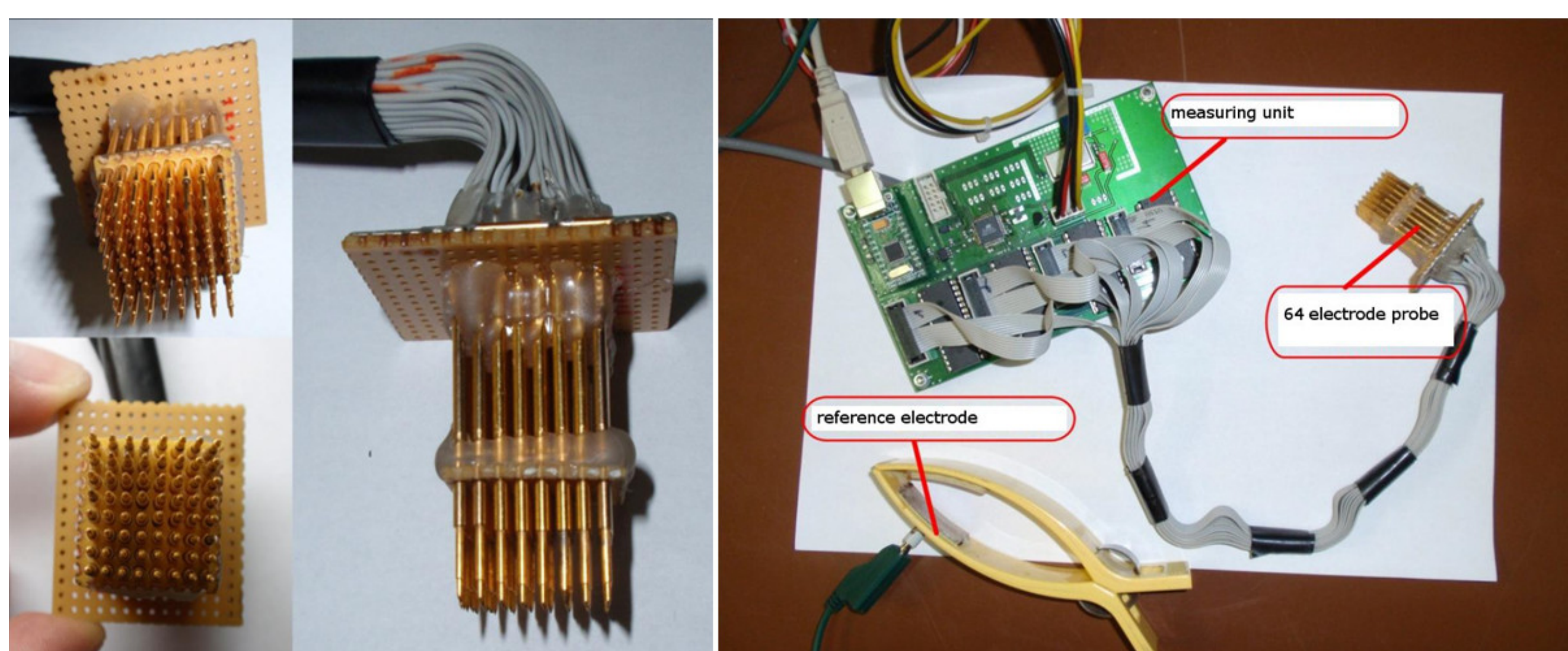


Fig.1: Left: Needle electrode probe with telescopic tips. Right: Measuring unit with probe head and reference electrode.

Results

- Data from several subjects covered impedance maps from up to 10 different acupoint sites located on upper limbs.
- Results appeared to be inconsistent in terms of reliable localization of acupoint structures by means of spatial distribution of electrical impedance.
- Strictly isolated depression of impedance modulus surrounded by circular patterns was not found in most of the maps, however in some cases there was clear indication of it (Fig.2) [4].
- Several acupoints were localized as a region with increased impedance values (Fig. 2).
- Differential map samples promise improved distinction of impedance structures in acupoint maps (Fig.3).

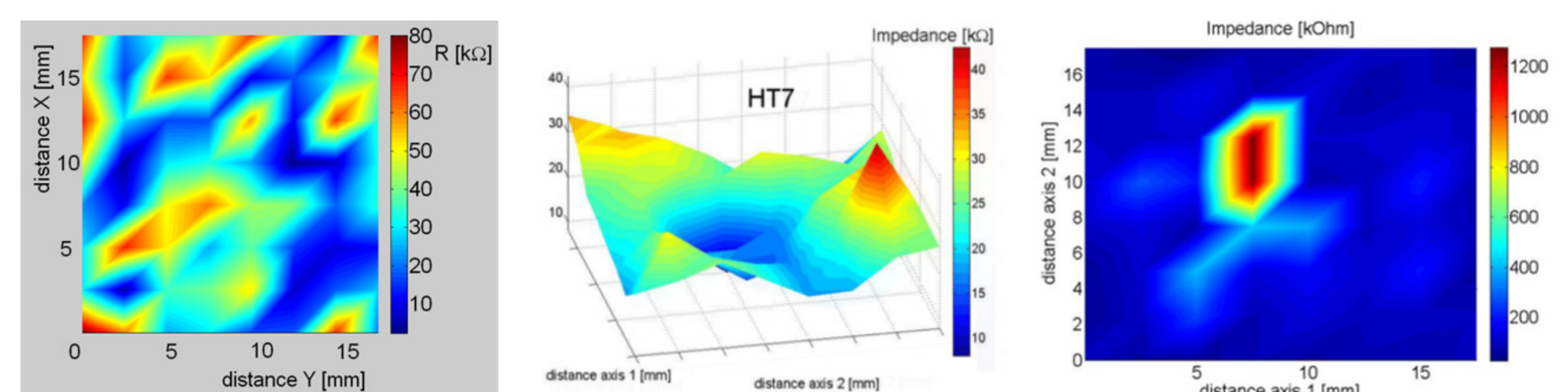


Fig.2: Samples of impedance maps of acupuncture points measured at 1 kHz. Left: Typical impedance variations without successful localization of acupoint. Middle: 3D view of decreased impedance of possible HT7 point. Right: Increased impedance in the area of PC6 point.

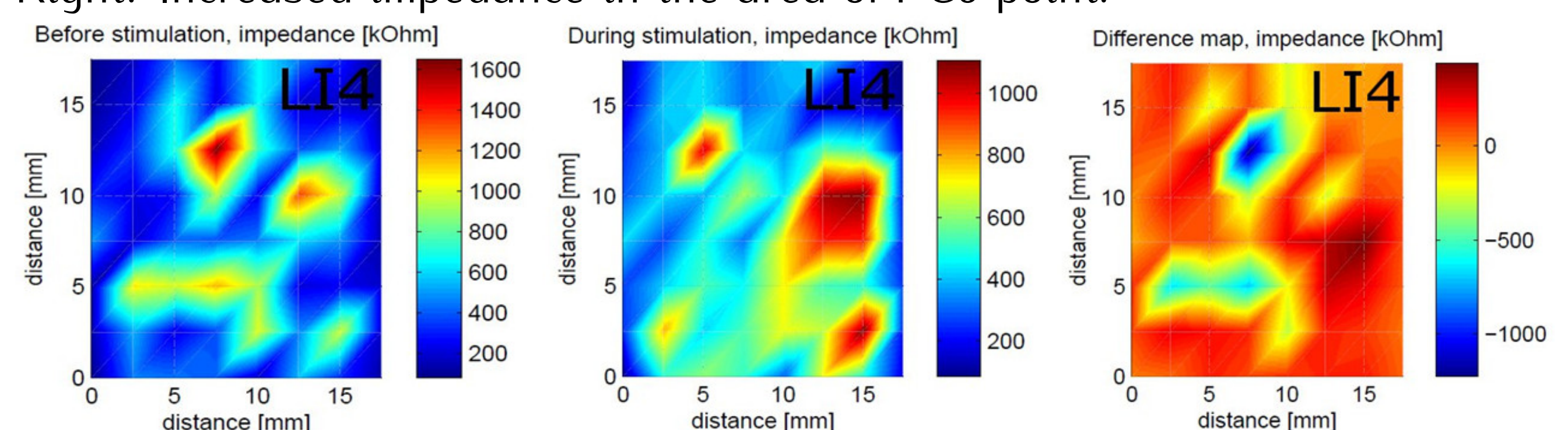


Fig.3: Procedure for enhanced visualization, Li4 point: Differential map (right) is produced by subtraction of the two previous maps obtained during and before electro-acupuncture stimulation.

Conclusions

- In this research area we struggle with number of sensitive and variable conditions of measurement.
- Gradual improvement of complex methodology and measurement procedure procedure (proper acupoint localization, skin preparation, electrode properties, stimulation parameters, as well as measurement unit upgrades) gives a chance that consistent localization of acupuncture points by means of distinct electrical properties might not only be feasible, but also may provide bases for invaluable diagnostic and therapeutic applications.

Literature cited

- [1]: Ahn AC et al.: Electrical properties of acupuncture points and meridians: a systematic review. *Bioelectromagnetics* 29: 245-256, 2008.
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