Bioelectrical properties of human body
Impedance analysis of acupuncture points

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Outline:

- introduction
- bio-oscillations
- acupuncture
- impedance analysis of acupuncture points
- conclusions

Motivation

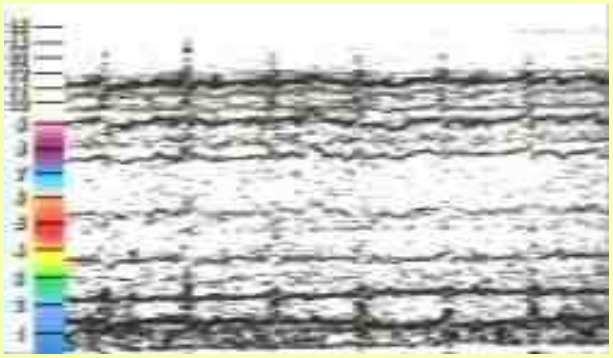
- novel ways of measuring bioelectrical properties of human body with strong diagnostic and therapeutic potential
- unknown principles touching foundations of natural sciences and our - human operation
- gate to different paradigm-changing realms: information and energy medicine, composition and nature of human beings, fundamental physics (new electromagnetics)
- prove or disprove electrical detection of acupuncture points while staying independant from acupuncture theory
- reveal principles of operation of variety of related devices (bioresonance, zappers)

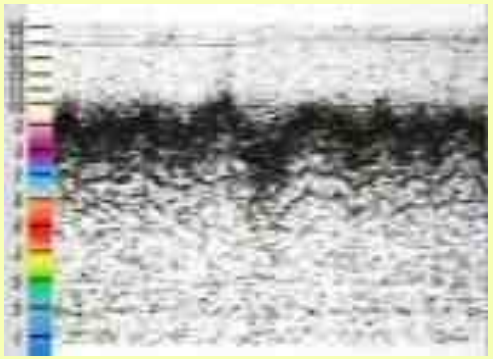
Bio-oscillations

- living cells contain both free and bound electric charges in the form of ions and polar molecules – there are sensitive to electric fields and currents
- generation of endogenous EM fields has been observed in a wide frequency range (0 - 10^{15} Hz) [Cifra, 2010]
- the intensity of these fields is usually extremely low, it makes sense to talk rather about the transmission of information than energy
- qualitative and quantitative characteristics of these fields may reflect the condition of the organism and its various pathologies

Bio-oscillations

- Electrical biopotentials: In conventional medicine, the electrical measurements of useful biopotentials are limited to frequency range not exceeding 1 kHz.
- ECG, EEG and EMG
- Valerie Hunt developed in 1970's a high frequency AuraMeter which recorded the bioelectrical activity from the body's surface with frequencies from 0 - 250,000 Hz.
- Reflecting health, emotional, and spiritual status:

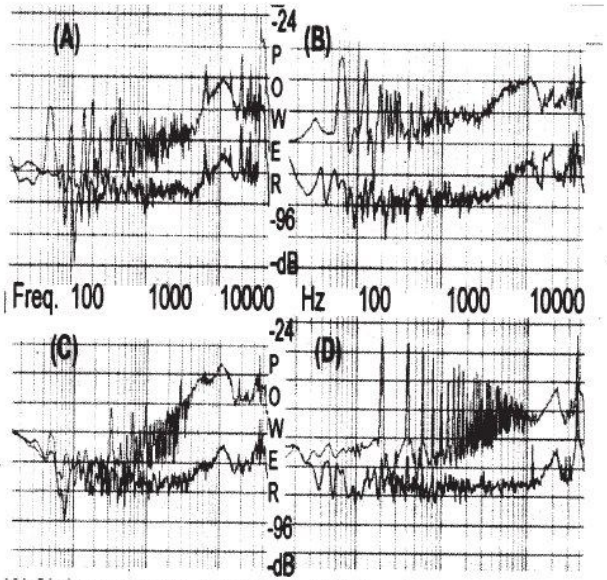




Bio-oscillations

- Mendanha (2008): A method for computerized recording and analysis of high frequency biopotentials (oscillometry), 0-45 kHz
- low-cost solution: PC audio card + surface EGG electrodes for conductive and inductive (contactless) signal pick up
- alterations during yoga and meditation

- observation of natural dynamics
- information contend in spectral domain
- spectral dynamics: wavelet analysis



(A) Sitting on mat in disharmony (B) lying down
(C) Abdominal breath holding (D) Harmony following meditation
Upper trace is the electrical recording on skin surface of left wrist.
and the lower inductive activity (log. FFT View)

Therapeutic frequencies

- Barbault (2009): Amplitude-modulated electromagnetic fields for the treatment of cancer: Discovery of tumor-specific frequencies and assessment of a novel therapeutic approach
- "Law Energy Emission Therapy“
- modulated EM frequencies ranged from 0 to 114 kHz with carrier frequency lying in the RF band
- contactless application through the mouth
- Biofeedback detection of tissue response: measurements of variations in skin electrical resistance, pulse amplitude and blood pressure

Therapeutic frequencies

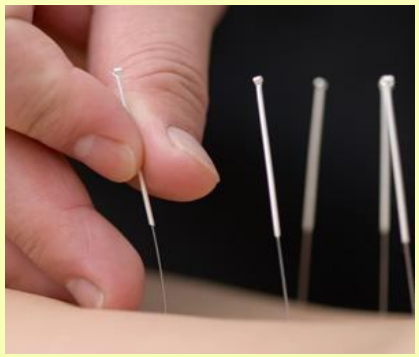
- for more than 160 patients with 15 types of tumors were identified together 1500 frequencies, of which 77% of tumor-specific and 22% were common to two or more types of tumors
- the treatment was applied with 10 to 300 frequencies simultaneouselly
- partial or complete response was observed in terms of long-term stabilization of the state
- the method is tailored to the individual patient and with the absence of side effects
- "Trigger Effect" [Vorst, 2006]: low energy but highly targeted stimulus may cause a trigger effect on biological subsystems. Impact not just on local destination but on the whole organism

Acupuncture

- There is an invisible dissipative structure of EM field which in mainly composed of an interference patterns of standing waves in the resonance cavity of human body under the condition of permanent support of energy in an open system. To some extent the invisible structure is corresponding to the mysterious acupuncture system and is closely related to different modalities of energetic medicine (Zhang 2003).

Acupuncture

- acupuncture is one of the oldest healing practices of the world and is one of the key components of traditional Chinese medicine
- google scholar finds the keyword acupuncture in 260 000 items and Pubmed in 17 000 items
- in Germany, every year has been recorded several million records of patients who use the method derived from acupuncture and in the country operates 30 000 doctors organized in medical acupuncture societies
- it is fully accepted by medical establishment, also by academic medicine, health insurance companies reimburse the selected tasks

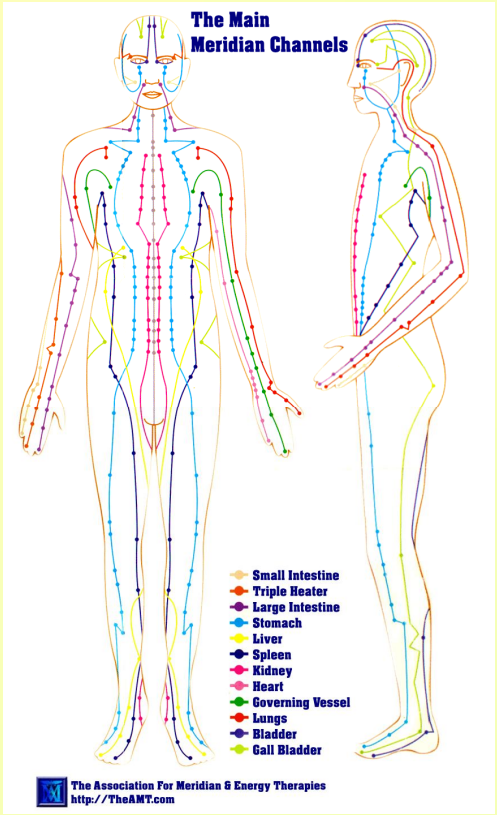


Acupuncture

- In acupuncture and related fields it is assumed that there are special pathways in the body called meridians which are connected to main body systems, such as cardio-vascular, respiratory, digestive, etc. In this concept the pathways are exposed to the surface of human body in so called acupuncture points localized on skin surface.
- In acupuncture are specific anatomic points stimulated by various techniques, mostly by injecting thin metal needles for the purpose of therapeutic action. These points may be seen as poly-modal structures positioned on the skin in areas with higher density of neuro-vascular structures. Tracks create their interconnection and should be composed of liquid systems, respectively by sparse connective tissue unrelated by blood or lymph vessels.
- Although use of acupuncture is relatively well established in Western medicine as a complementary diagnostic and therapeutic tool, its physical and medical characterization is still largely unknown.

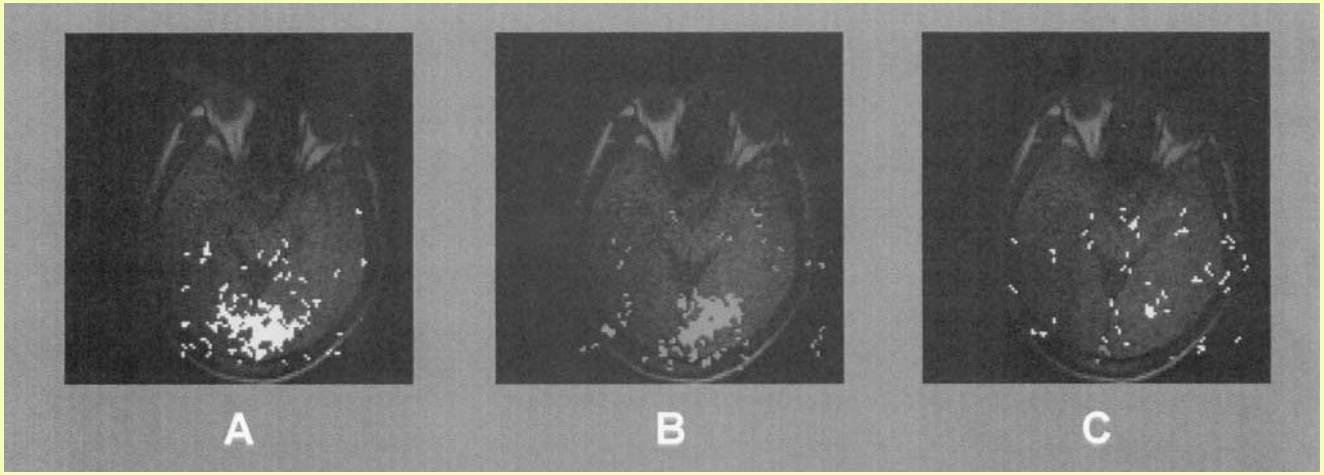
Acupuncture

- general mechanisms of action include stimulation of the nervous, immune, lymphatic and endocrine system
- biological response is local and distant - guided by sensory neurons in the CNS
- excretion of endogenous opioids during acupuncture analgesia in the CNS
- activation of the hypothalamus
- secretion of neurotransmitters and neurohormones, regulation of blood flow, changes in immune function



Acupuncture

- fMRI and PET studies
- Jones et al. (2002): Ultrasonic Acupuncture and the Correlation Between Acupuncture Stimulation and the Activation of Associated Brain Cortices Using Functional Magnetic Resonance Imaging
- visual cortex activation by ultrasound stimulation applied to acupuncture point on the foot, which is known as a therapeutic point for visual impairment

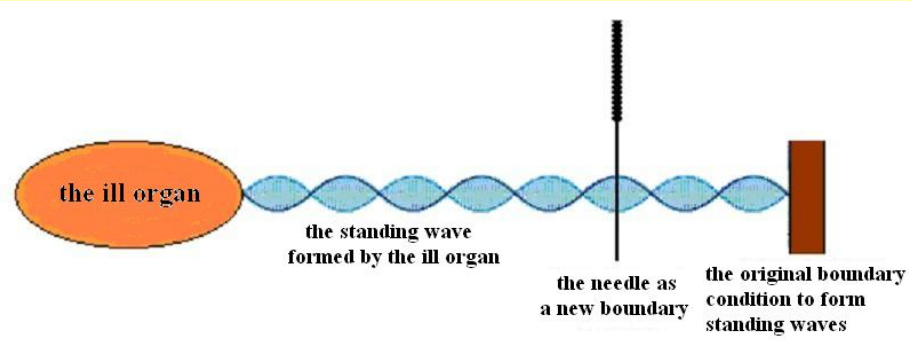


Acupuncture

- Governing biophysical principles studied by Zhang (2003): hypothesized on the existence of dissipative structure of electromagnetic field interference patterns formed by standing waves in resonant cavities of the human body under conditions of constant supply of energy in the physical open system.

- Han (2005): acupuncture points and pathways can be imagined as structures with different physical and physiological properties that are created in 3D by multiple interference of standing electromagnetic waves.

Acupuncture



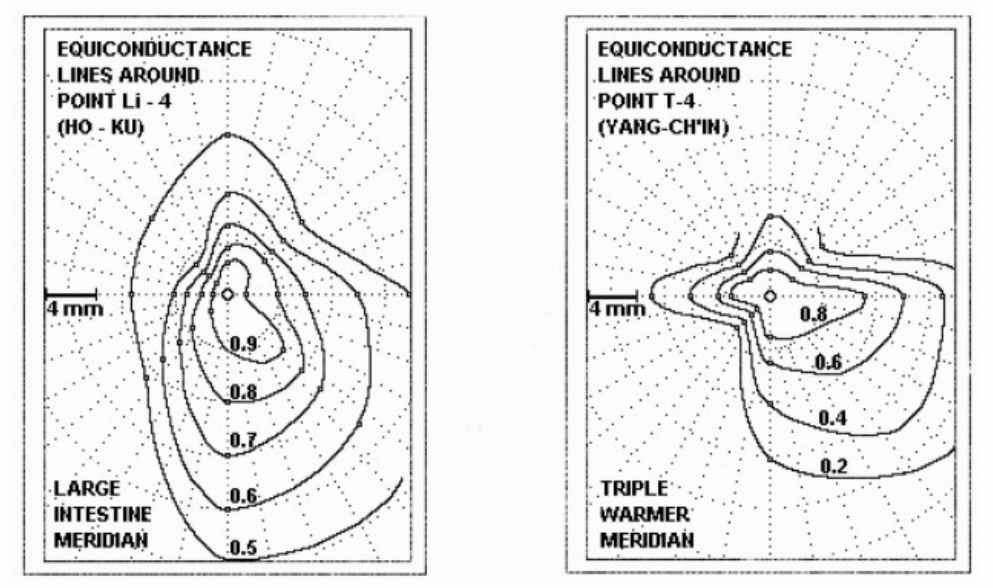
- interference pattern of electromagnetic waves, it becomes much easy to understand why a needle have to insert into a point with the highest body conductivity, because the highest conductivity point is on some peak of standing wave, and also the place where a needle had biggest influence to destroy the ill-standing wave as introducing a new boundary condition (Zhang 2012)

Acupuncture

- Szasz (2008) sees acupuncture system as well as the electromagnetic phenomenon through access of network
- meridians are dynamic systems based on scale-free fractal structures

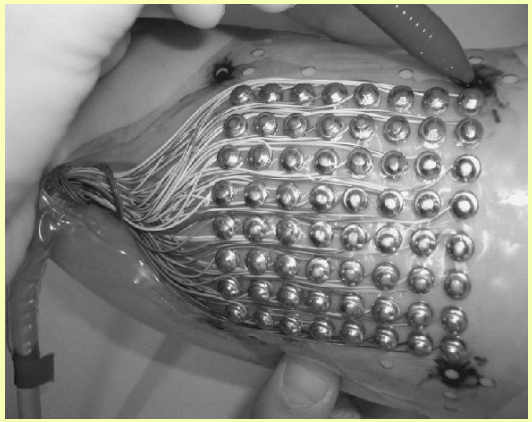
Electrical properties of acupuncture points

- Becker (1976):



Electrical properties of acupuncture points

- Ahn (2008): Electrical properties of acupuncture points and meridians, a systematic review: preliminary evidence supports these findings however it is still impossible to determine whether acupuncture structures possess distinct electrical characteristics until better quality studies are performed.
- Pearson 2007: acupuncture have not lower impedance
- Kramer 2009: 63% not electrically distinct, 26% lower while 11% higher electrical skin resistance.
- Call to precisely replicate Becker stydy from 1976 (Colbert 2009)



Electrical properties of acupuncture points

- experimental evidence: DC - lower resistance, AC - lower impedance while higher capacity
- controversial outcomes: some studies found no distinction from surrounding tissues
- results are heavily dependant on measurement characteristics: skin surface, presence of sweat glands, electrode geometry and polarizability, contact pressure,...
- fluctuation of electrical properties in time (24 h cycles,...)
- AC frequency of measurement determines depth of penetration into the skin: majority of research deals only with low-frequency or direct current – hence only the epidermis dominated by the dead stratum corneum is covered

Aim of the study

- localization of acupuncture points

Impedance analysis:

- in acoustic frequency range
- in radiofrequency range

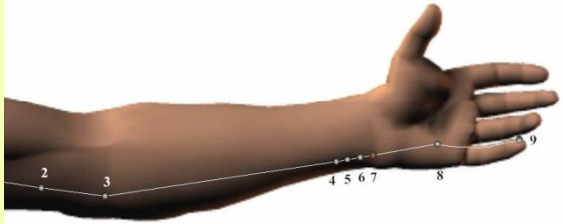
Secret life of acupuncture points

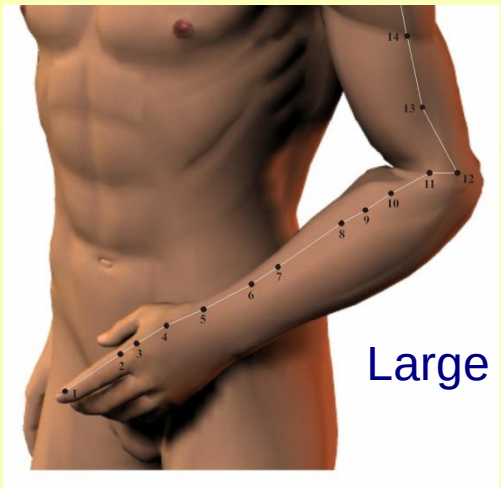
- Space: localization: no singularities, oval 1 x 0.7 cm
- Time: drifting spots
- Mind: determined/influenced by state of the person, variety of psychological, emotional and spiritual factors

Methods

- choice of biologically active points: LI-4, TW-3, HT-7, PC-6, LU-7, HT-3, PC-3, LU-5, LI-11, TW-8,TW-9

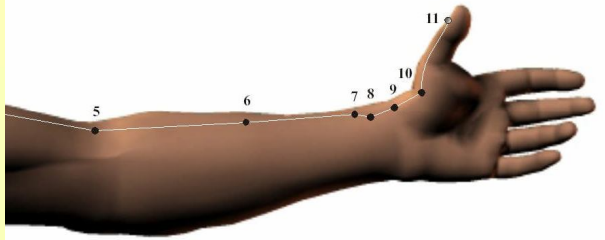
Heart meridian





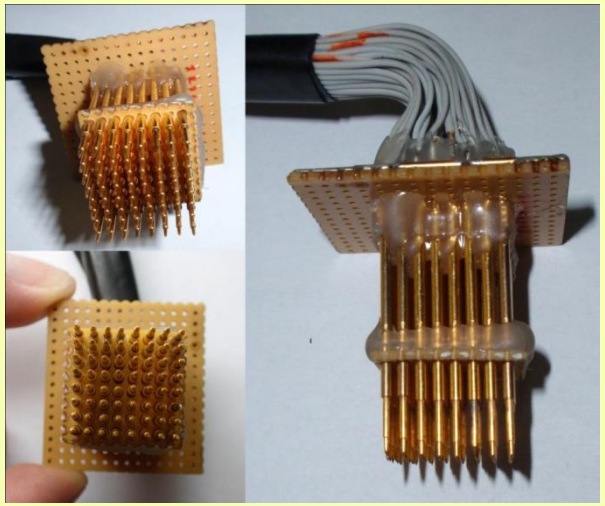
Large intestine meridian

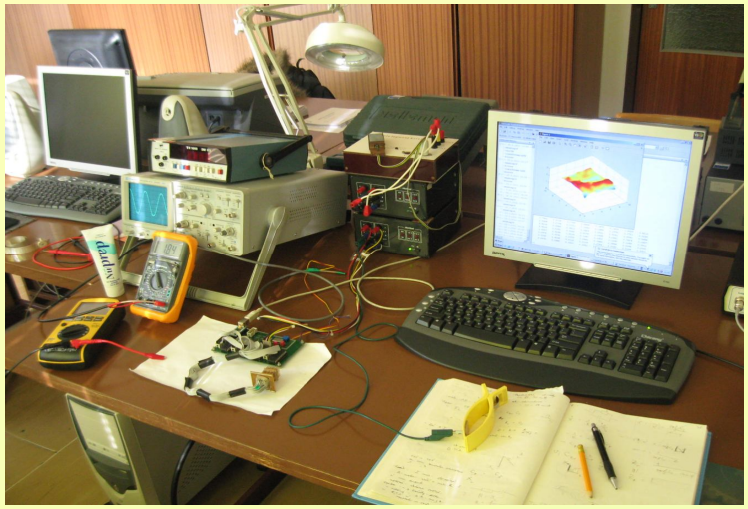
Lung meridian



Methods

- grid of 8 x 8 telescopic needle electrodes –constant pressure guaranteed
- monopolar arrangement with clamp reference electrode on the opposite arm (~6 cm^2)
- frequency: 1 kHz
- covered area: 17.5 mm x 17.5 mm





Can it be measured?

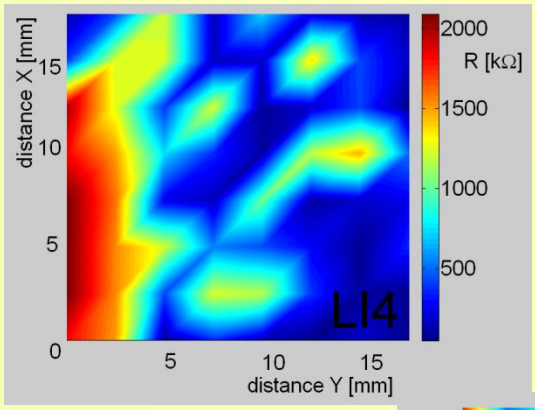
- On any body at any acupuncture point, and without specialist in acupuncture?
- Develop new procedure, universal and minimally invasive
- Visualization of acupuncture points – contrast increase, sensibilization
- Choice of the most suitable points
- Frequencies for stimulation: lower (7-60 Hz), for excitation – higher (120 kHz) inhibition
- Shifted impedance: decreased - inflammation, increased – attenuation
- Not only just measure successfully but also not to disturb human organism
- Use resonance/natural frequency of meridians and acu. points
- Resprect day time when each meridian with its organs are active
- Latency

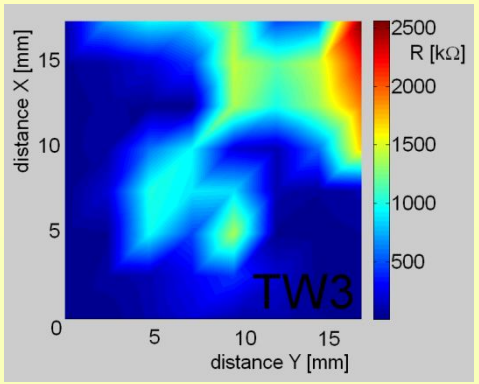
Methods

- Before, during, and after stimulation: direct measurement or
- Differential maps: not visible before, neither during or after stimulation
- Skin and electrode preparation
- Observe dynamics, how do they live – long term biomesurements, during 24 h cycles
- Time evolution of maps: AP may travel – small drift, as they could not be strictly locked to anatomical substrate but inner EM intereference patterns and pathways, standing waves
- Detection of AP points by acupuncturists: distance measure (cuns) + subjective feeling of patients (pain, up to10 qualities like pain, titillation) = Art – complex task – combine classical objective and CAM approaches
- Sensitive system, experimenting with humans
- limited reproducibility, interference by measurement

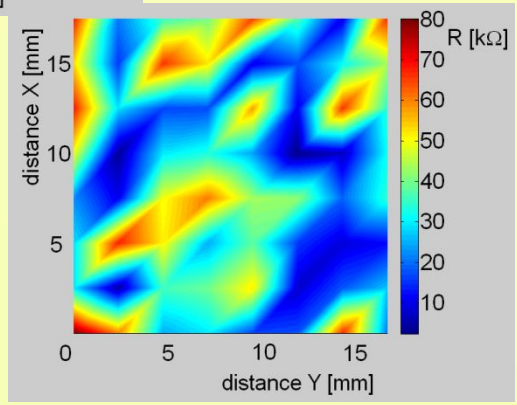
Impedance maps

- in most of the cases distinctive minima surrounded by circular patterns were not found
- considerable variations within mm distance: up to the 1 order of magnitude
- reproducibility only under restricted conditions
-

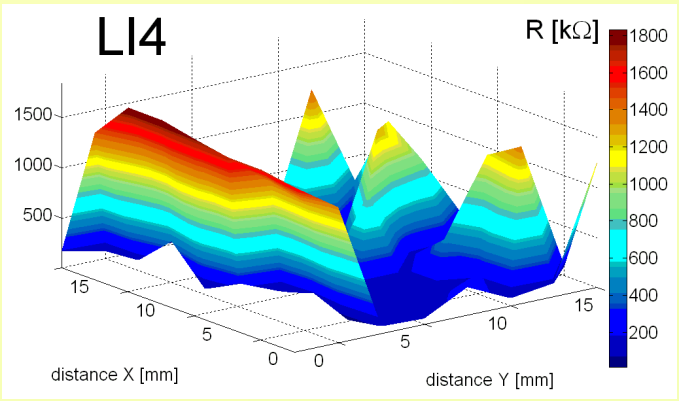




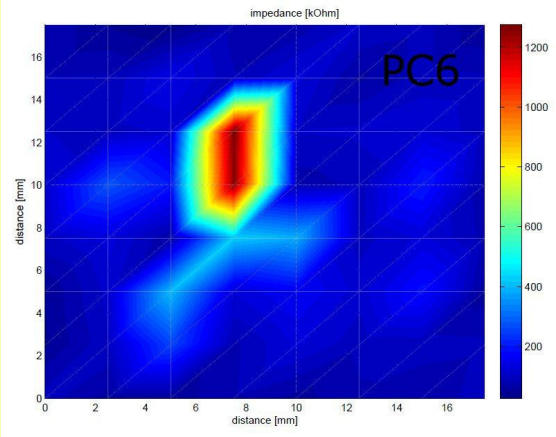
control:

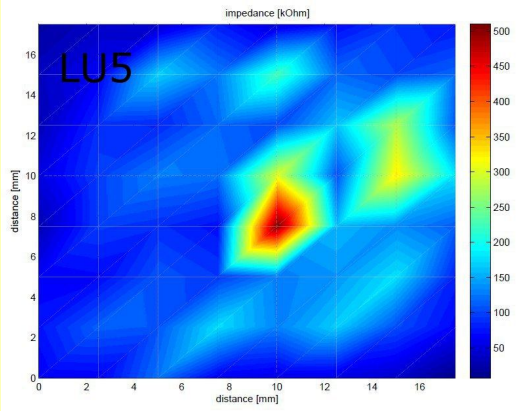


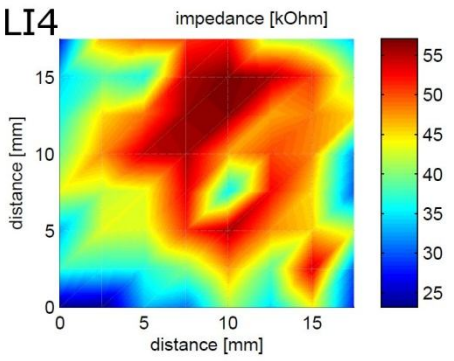
3D plot:

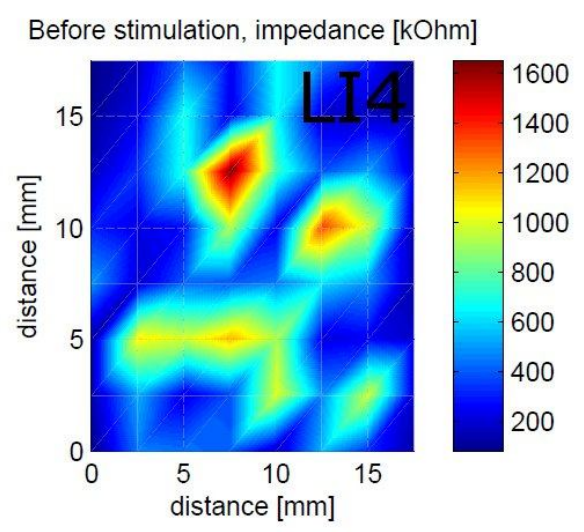


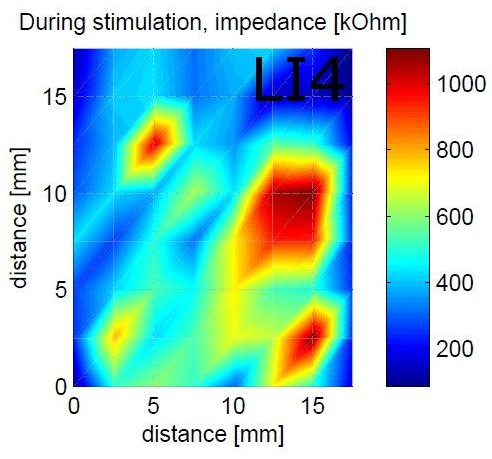
Impedance maps

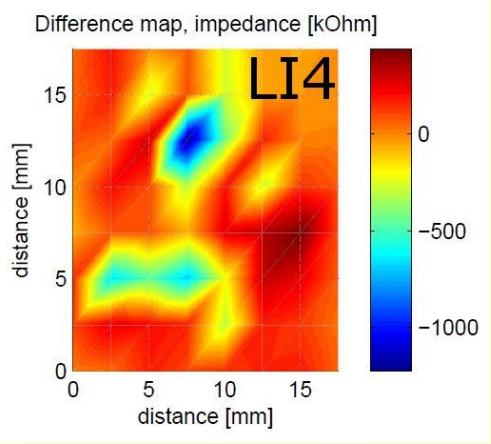






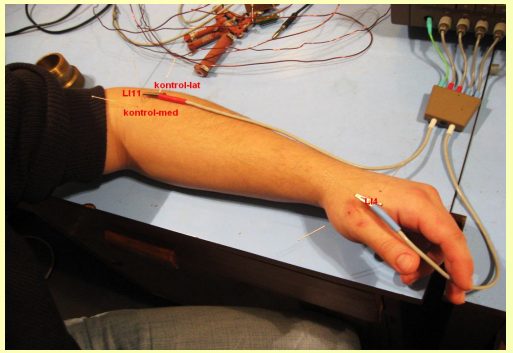


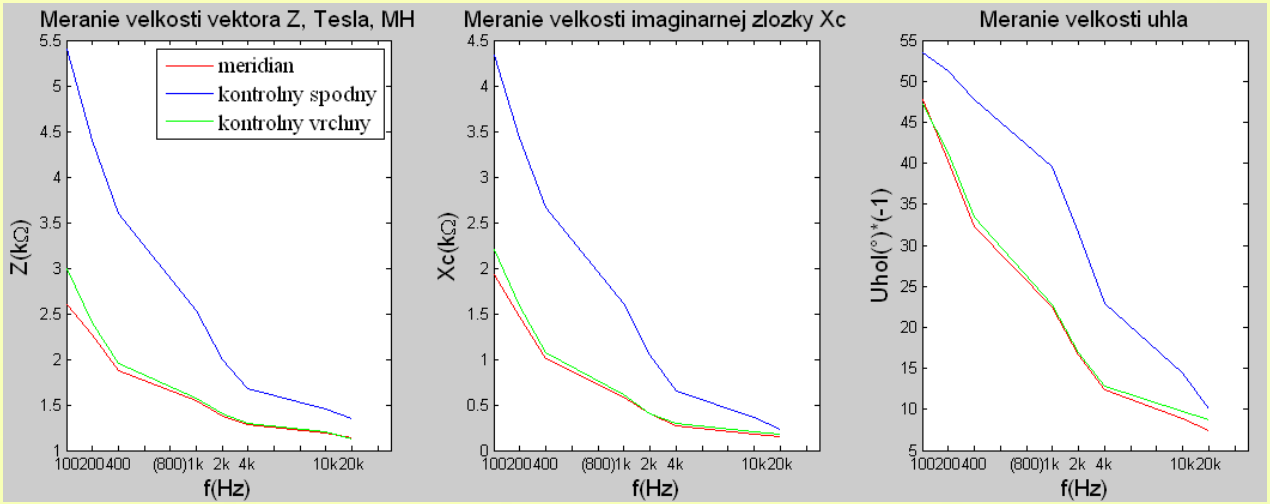




Impedance in radio frequency range

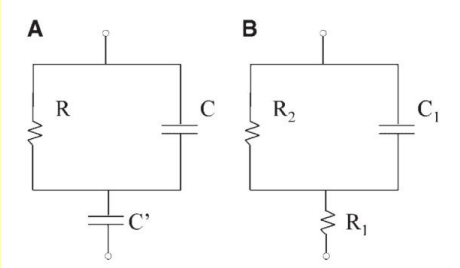
- Meridian LI4-LI11
- Control points: medial, lateral
- TESLA impedance analyzer, pseudo-4-wire method
- elektródach



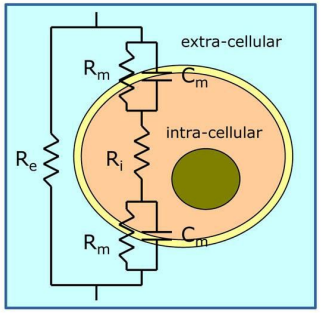


Circuit models

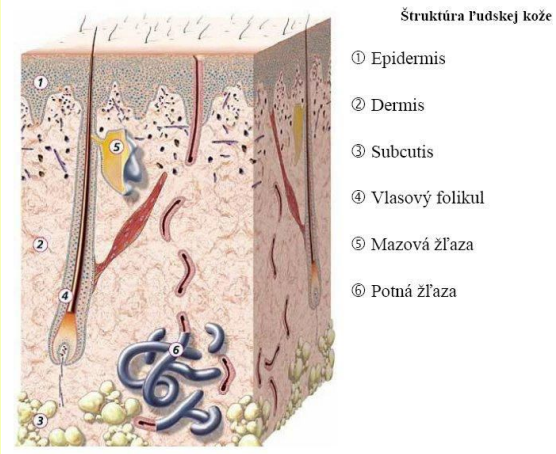
- Johng 2002 and Reichmanis 1977:

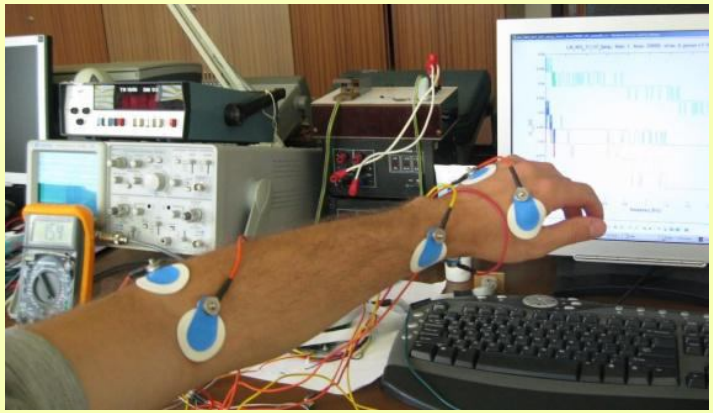


$$Z = \frac{1}{R^{-1} + i\omega C} + \frac{1}{i\omega C'}$$



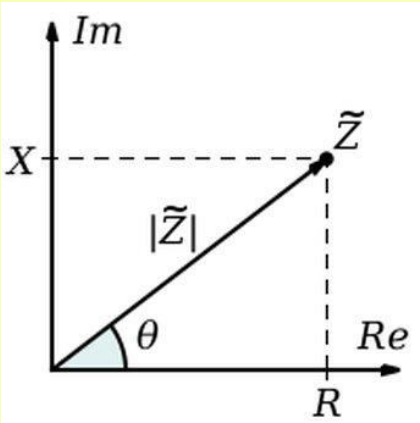
- elements based on skin layers: epidermis on surface with dry tissue of stratum corneum – parallel R with C. Serial R: other skin compartments – dermis

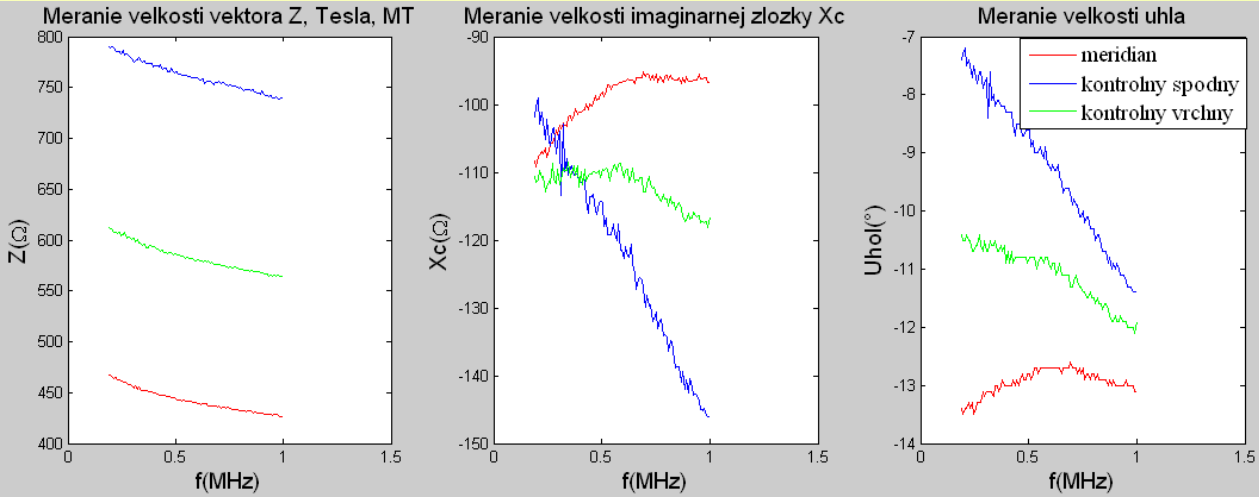




Impedance in radio frequency range

- Tomco RF Impedance analyzer
- needle or ECG electrodes + cylinder reference electrode
- electromagnetically shielded room





Implications and lessons learnt

- caution is warranted when developing, using, and interpreting results from electrodermal screening devices
- acupuncture impedance pens: example of applied technology when solid research is delayed, what results in misleading simplifying truth
- opinion correction: shift from naive believe from semi-popular literature towards focus on original resources and first hand experiments
- CAM electro-acupuncture: attributes of training, art and intuition

Conclusions and visions

- it is possible to measure electrical properties of acupuncture points
- task is complex, with many factors involved
- expected results are nonuniform
- strong diagnostic and therapeutic potential of both approaches: impedance and biopotential measurement
- From neurofeedback to higher frequency biopotential and acupuncture impedance biofeedback
- bioelectrocity devices (bioresonance): hidden know-how → open source technology

Thank you for your attention!