Custom design of multi-electrode arrays for stimulation and recording application

Matija Strbac, Vladimir Kojic, Milos Kostic, Jovana Malesevic, Goran Bijelic

UNIVERSITY OF Southampton

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BCMATERIALS BASQUE CENTER FOR MATERIALS, APPLICATIONS & NANOSTRUCTURES

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RISE

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Screen printed multi-electrode arrays

Design

- More than 100 different electrodes and sensor prototypes designed and manufactured
- Multilayer design – produced electrodes consisting of more than 10 layers

Pastes/Inks

- Experience with conductive and dielectric pastes for biomedical applications
- Pilot tests with newly developed inks (e.g. cellulose based ink by Tecnalia Biomat)

Substrates

- Polymer (PET, PS, PC), cellulose, Tyvek and textile based substrates

Printing/Production

- High resolution fast prototyping of small series

Electrodes
- Recording
- Stimulation
- Iontophoresis

Sensors
- Electrochemical/Microfluidic
- Pressure/Capacitive

Actuators
- Heaters
- Incorporation of active component

Tecnalia Serbia expetize in MEA design
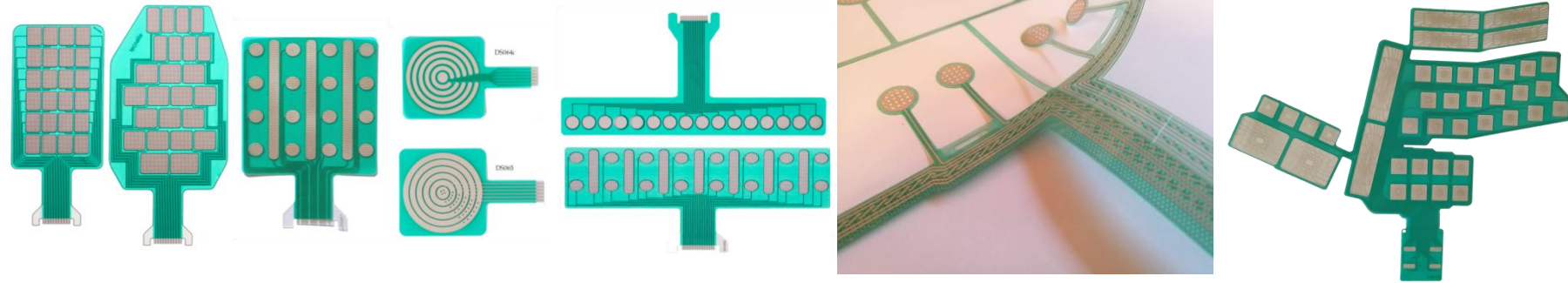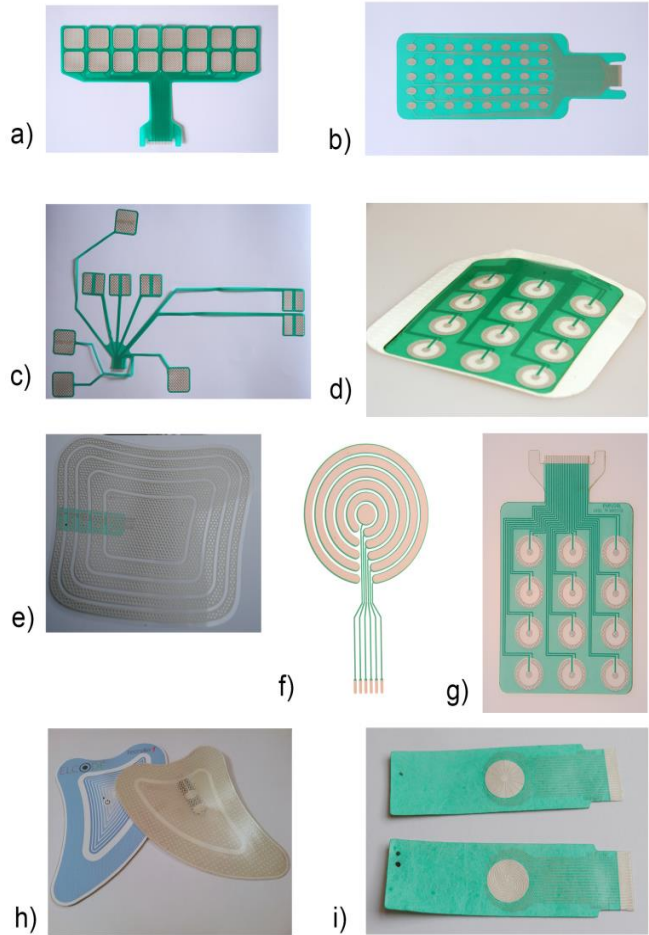
Muscle activation
- Forearm and upper arm
- Lower and upper back
- Peroneal nerve
- Quadriceps and soleus
- Abdominal muscles

Afferent stimulation
- Sensory substitution
- Tactile feedback on fingertips

Recording electrodes
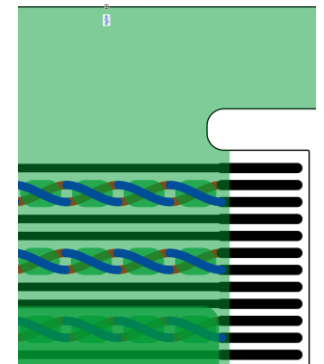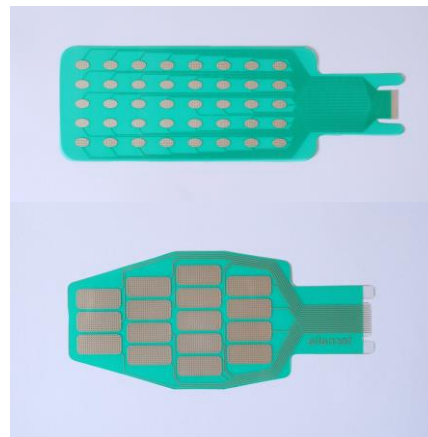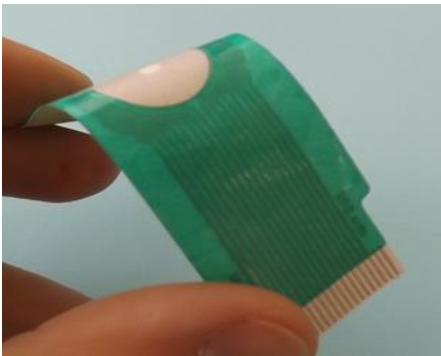- Various designs of EMG electrodes
- Various designs of EEG electrodes

MEA design and optimization

MEA design considerations

- MEA surface and size
- Placement
- Number of electrodes
- Configuration of electrodes
- Arrangement of electrodes
- Size and shape of pads

Optimization of the design

- Anatomy
- Current flow
  - Simulations
  - Animal model
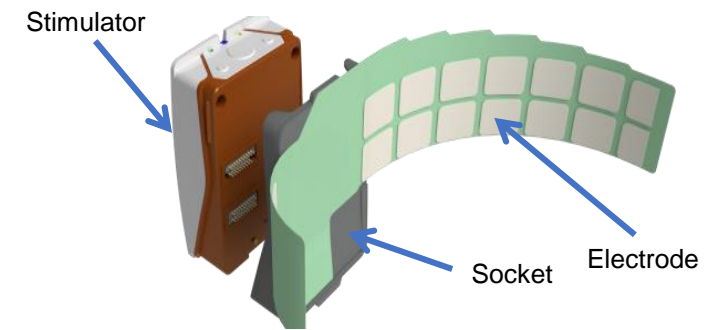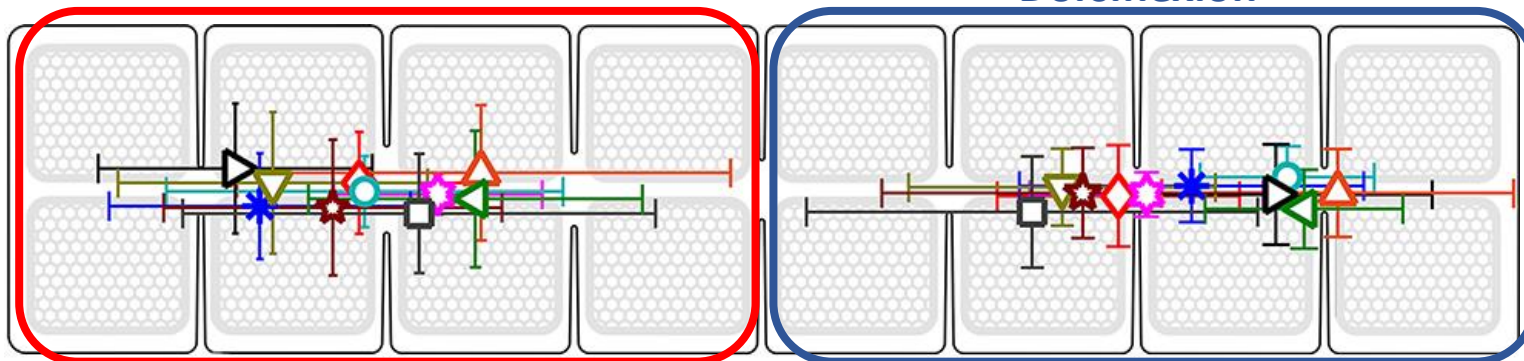- Electrical characteristics
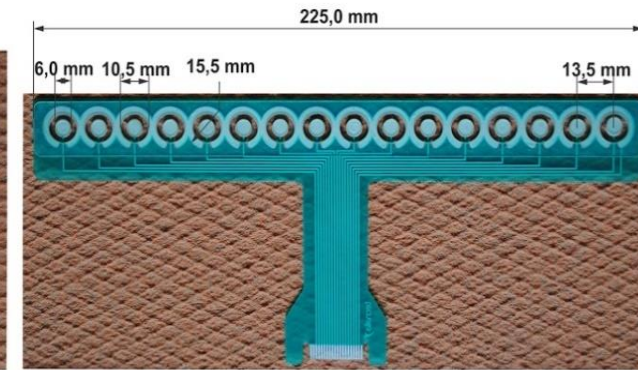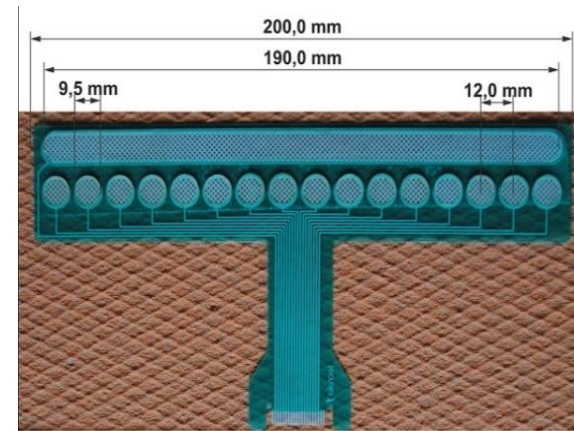- In vivo experiments

Example: Design for FES hand rehabilation

Example: Design for Dropfoot
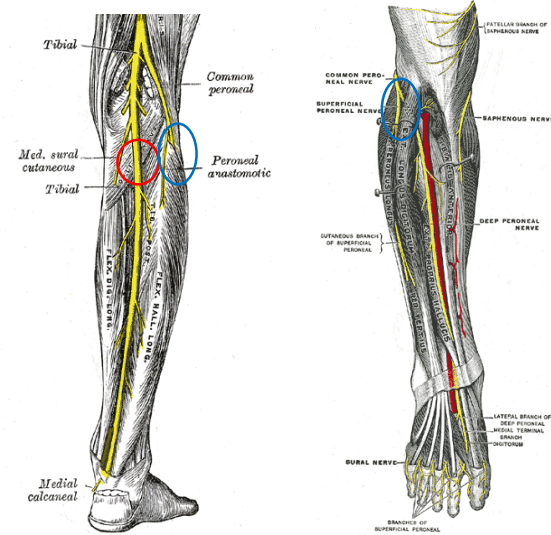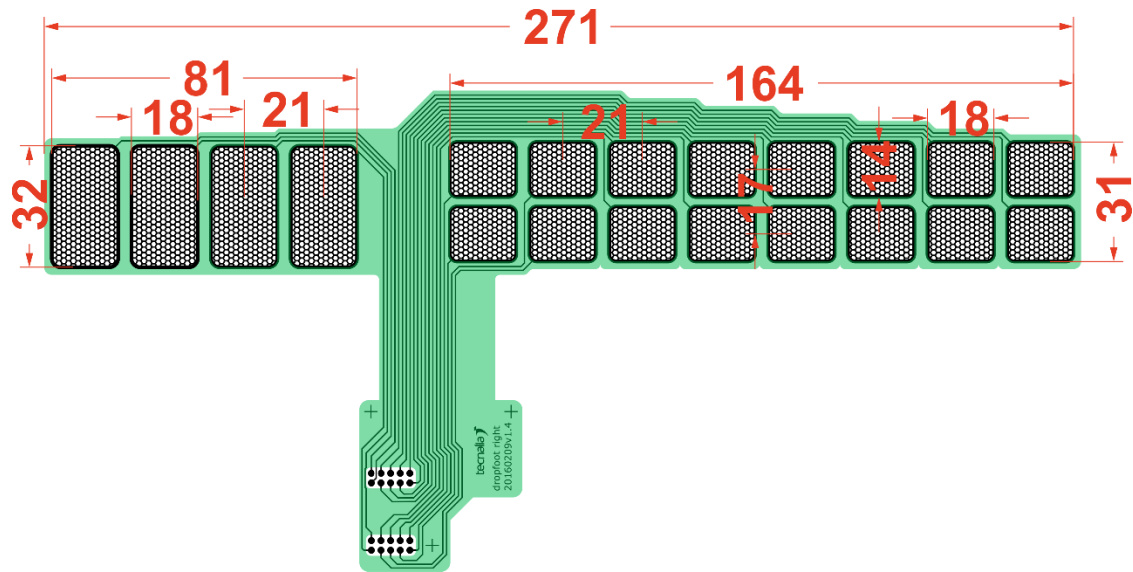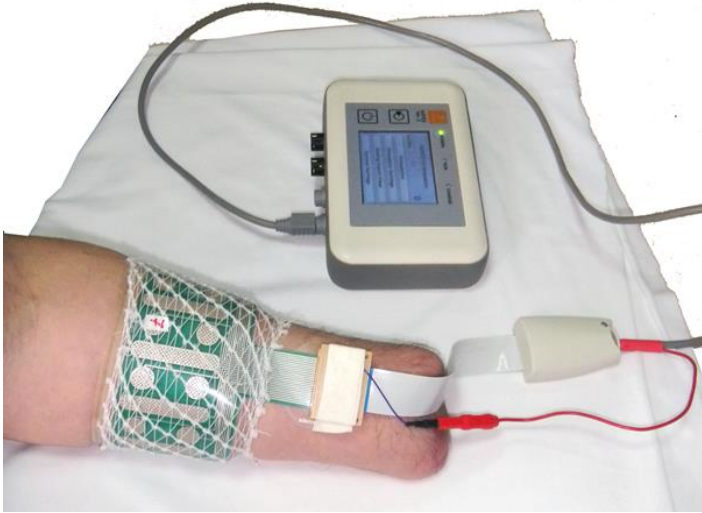

Plantar flexion
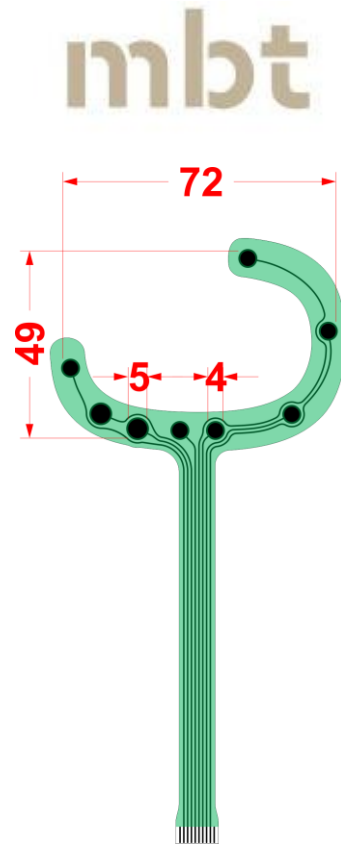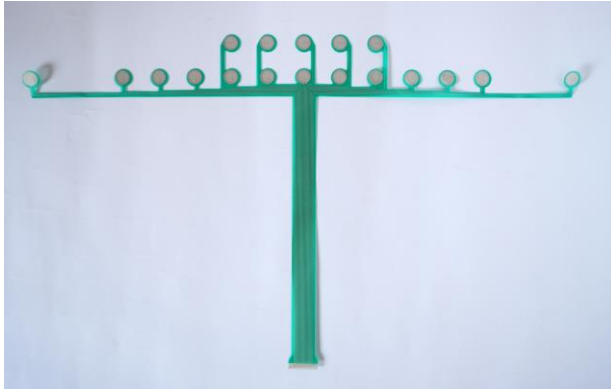
Dorsiflexion

Stimulator

Socket

Electrode

Example: Design for sensory substitution
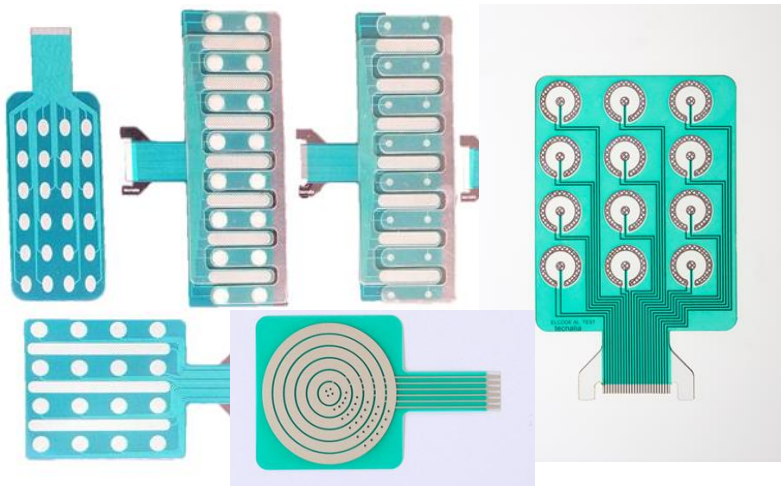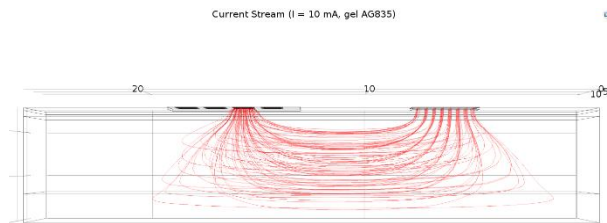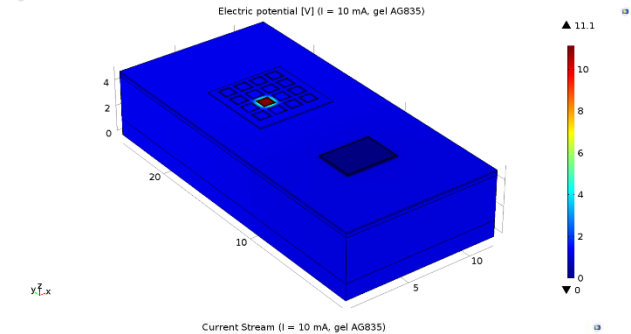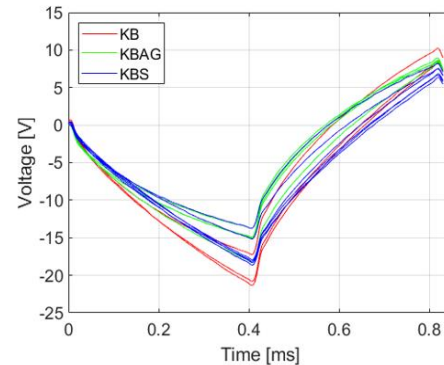
Example: Design for EEG recording

SMARTFONES

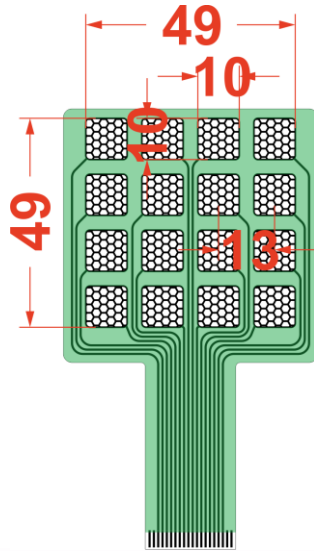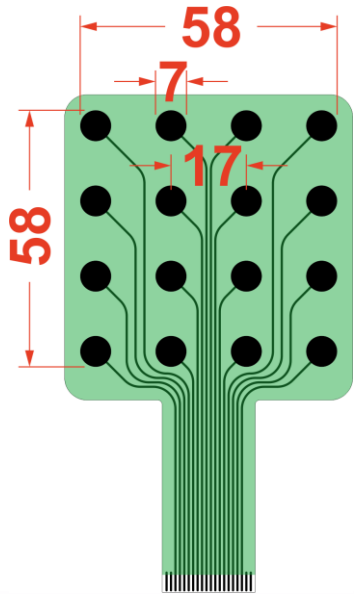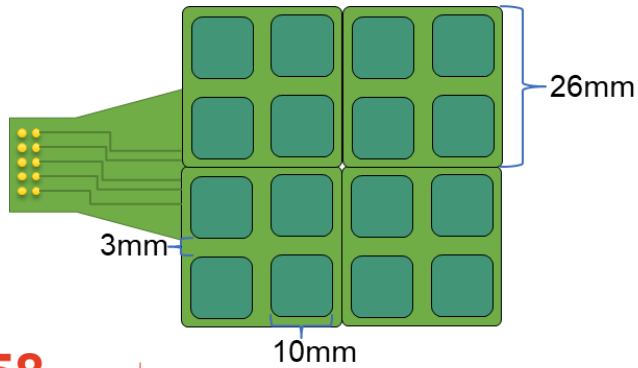# Example: Design for WEARPLEX
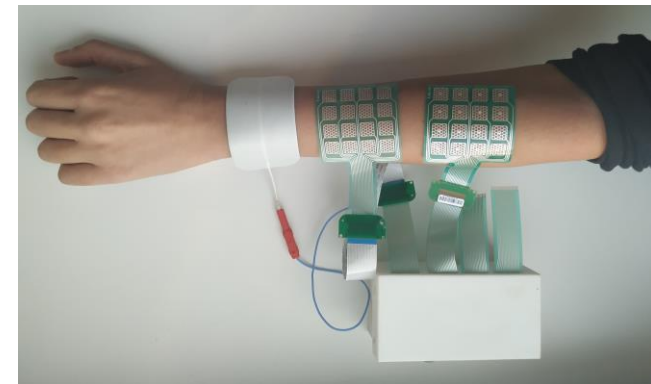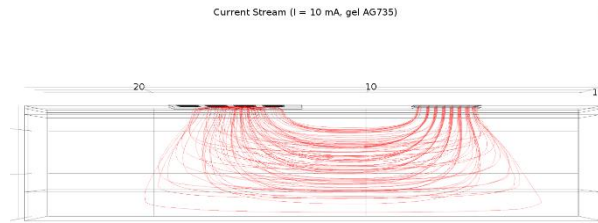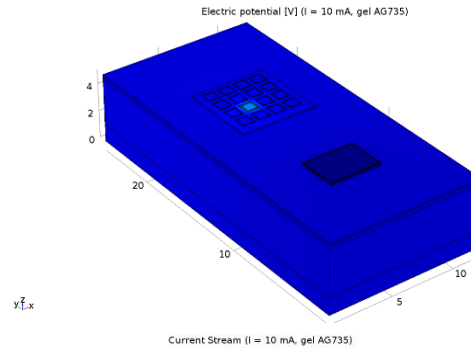
Conclusion

MEA design
- Of high relevance for the results in stimulation and recording
- Not always straight forward due to conflicting requirements
- Adaptation after in-vivo trials is usually recommended

Expertise
- Necessary for defining specs and recs for application of interest
- Important for doing tests, establishing flaws and shortcomings
- Critical for updating the design based on obtained results