Costa Rican - German
Days of
Innovation

Group 3

Biotechnology and Technology

Miniaturized Systems for Broadband Cell Inspection

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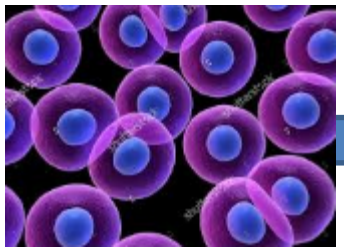
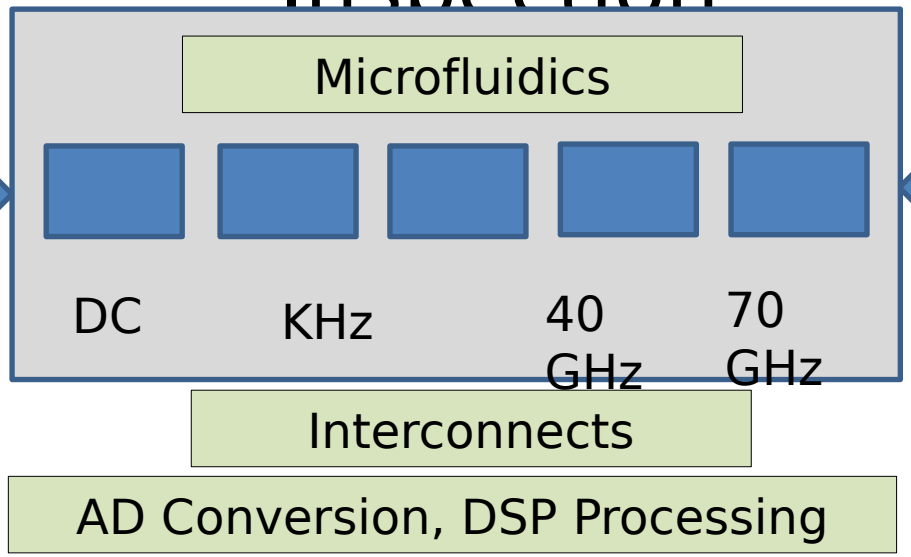
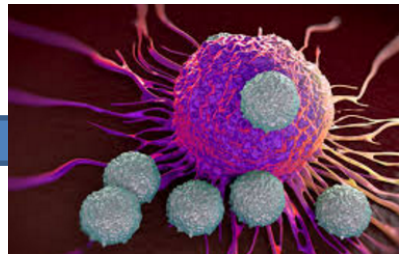
Costa Rica, December, 2016

Group 3

Miniaturized Systems for Broadband Cell Inspection







Current Status

On going Bilateral Research-Collaborations:

- NEM-TUHH & IE-TEC, electrical Impedance Spectroscopy, since 2013

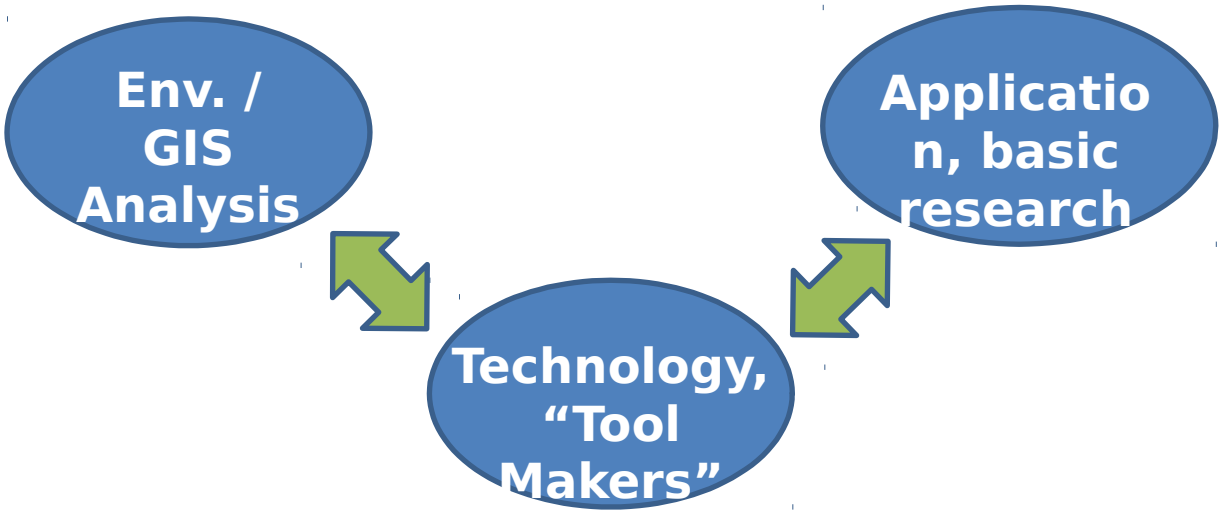
- TET-TUHH & IE-TEC, Signal Integrity and High-Speed Interconnects, since 2006

- BIO/TB - TUHH & CENIBIOT, TCI-LUH & CENIBIOT, Production, Characterization and Scaling up of Bioenzymes, since 2016

- U Potsdam - TEC - UNA, characterization and measurement of samples, since 2015.

2nd Workshop, STI Platform

Joint Actions (all groups)



- Look for inter-group collaboration possibilities
- PPP program DAAD (student and research exchange)
- PhD scholarships from MICITT in collaboration with DAAD
- Transform workshop to joint conference on a regular basis (e.g. every two years)

Joint Actions (Group 3)

- Exploratory non-funded work as preamble to future collaborations
- Create competence groups and roadmap/focus for each group
- Networking events / Summer Schools
- Map funding possibilities
- Roadmap for 5 years with project proposal
- Formulation of research proposals
- Involve other professional organizations (e.g. IEEE)
- Explore SME-Academy funding schemes for future collaborations
- Orient to innovations/products

Capability-Map (Summary)

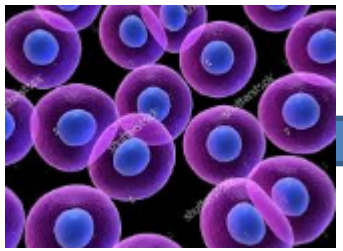
EM Theory, TUHH	EM analysis, numerical modeling and simulation, interconnect design
Nano EM, TUHH	IC circuit design, embedded system design
Microsys., TUHH	Microfluidic design and fabrication
IE-TEC, TUHH	IC Design, Prototype development and modeling, system integration
EQ-TEC, TUHH	Electrode chemical modification
CENIBIOT, CeNAT	Enzyme production, characterization and scaling up, biological assays
UTN	Food technology

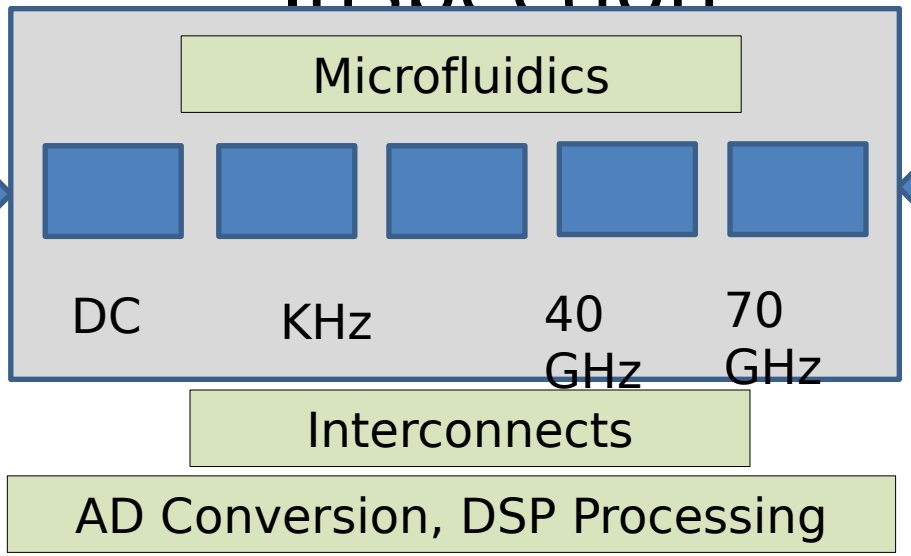
Topics for Collaboration, Group 3

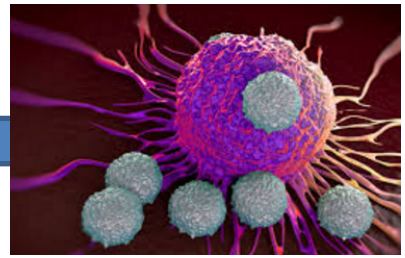
- Impedance spectroscopy for biomedical and environmental applications
- Microfluidics for biomedical applications
- System integration: power and signal integrity

Common Interest:

Miniaturized Systems for Broadband Cell Inspection

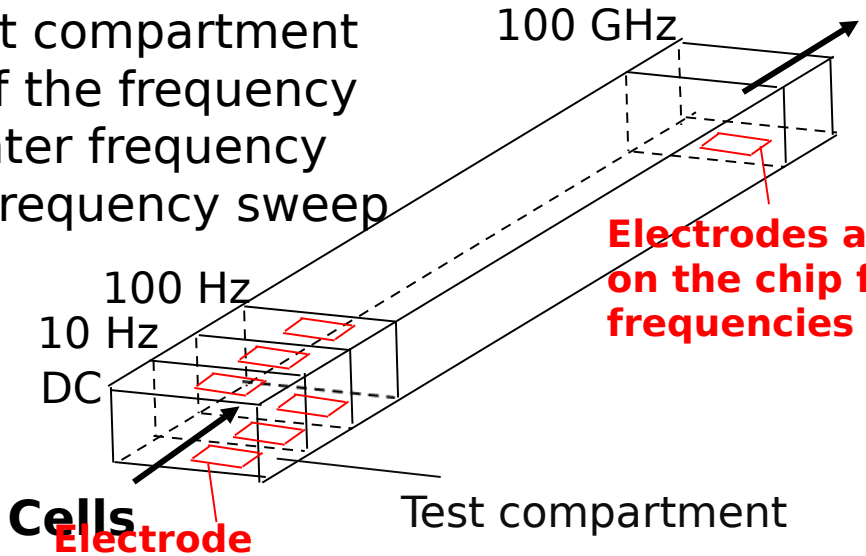






Topics for Collaboration, Group 3

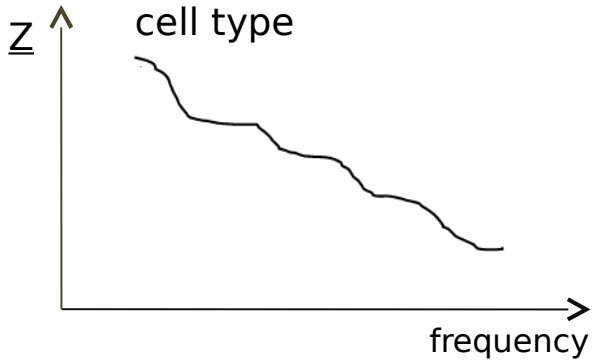
n each test compartment
variation of the frequency
around center frequency
=> Large frequency sweep



Electrodes are integrated on the chip for very high frequencies

Electrode
(separate electrodes or integrated in chip (better performance but more costly))

Z and phase-curves give a „fingerprint“ specific for each cell type

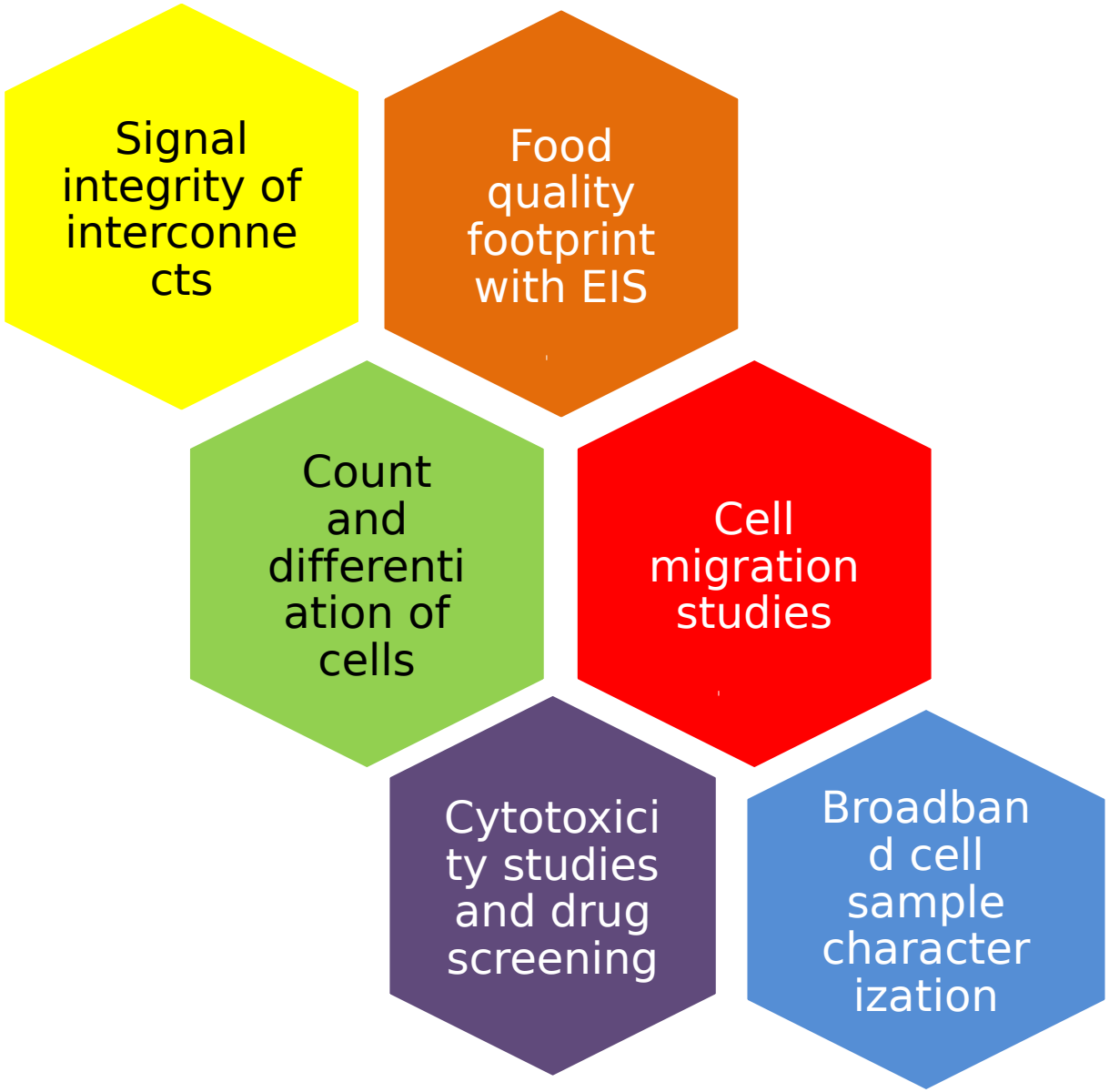


Cells are moved by
- laminar flow
- electrophoresis

System can be built step by step
Starting with low frequencies

Microfluidics for sorting of cells can be added.

Topics for Exploratory Work



Roadmap

Action	Timeframe
• **On going collaborations**	Immediate
• **Competence group definition**	first semester 2017
• **Non-funded exploratory initiatives**	first semester 2017
• **Identify points of collaborative work with other groups**	first semester 2017
• **Identify funding opportunities**	Second semester 2017
• **Proposal on e.g. Broadband cell characterization**	Second semester 2017
• **Networking event**	First semester 2018
• **Follow-up event (i.e. Costa Rica-Germany conference)**	First semester 2019 (decision point)

Capability Map (Detailed)

Institute of EM Theory, TUHH

Proven Competences

- 3D modeling and simulation of electromagnetic fields for interconnects, packages, and platforms (servers, ships, aircraft)
- Development of numerical algorithms for field simulation
- Characterization and mitigation of signal integrity problems at multi-GHz frequencies
- Analysis of electromagnetic interference problems
- Design of coils configurations for medical imaging

Contributions to Project

- Generation of electromagnetic cell model suitable for 3D simulation
- Simulation of electromagnetic fields in around simplified cell models
- Design of test electrodes and shielding for compartments
- Design of high frequency interconnects for microsystem
- Evaluation of parasitic electromagnetic effects and electromagnetic compatibilty aspects

Microsystems Institute, TUHH

Competences

- MEMS: Thin films deposition, Atomic Layer Deposition, Etching (chemical and physical), Microscopic fabrication in general
- Microfluidics

Contribution to project

- Microfluidic FEM Simulation
- Microfabrication of microchannels
- Microelectrodes fabrication
- Microflow optimization

Electronics Department, TEC

Proven Competences

- IC Circuit Design
- Modeling and simulation of interconnects and signal integrity
- System prototyping

Contributions to the Project

- Design of prototypes for cell characterization
- Numerical simulation and modeling of sample sistems
- Electrical circuit design and characterization
- System integration and testing

Chemistry Department, TEC

Competences

- Electrodes fabrication and chemical modification
- Electrochemical characterization
- Polymer chemistry

Contribution to the project

- Chemical modification of electrodes for biological and environmental sensing applications.
- Characterization of the interface.
- Polymer micro and nanostructuration.

UTN

Proven competences

- Nanotechonology is a current aplication on food (biosensors, trazabililty…)
- There are fields of research to be covered on nanotechnology applications
- Legislation on aplication of nanotecnology in food still uncleare
- Threre is a need to prevent food losses
- There is a demand on natural food demand

Contributions to project

- Exploratory work
- Bachelor, Lic., student (thesis programme)
- Field activities
- Funding search
- Actions to do collaborative work with CENIBiot (CENAT)

Universidad Técnica Nacional

CENIBIOT

Proven competences	Contribution to Project
Extraction purification characterization of nucleic acids Sequenciation and methylation analysis Analytical chemistry Industrial Enzymes Micro organism preparations Fermented foods Plant culture *in vitro* Microalgae culture Botanical material growth in Temporal Immersion Systems *In vitro* and *in vivo* biological assays	Bio-assays -Cell migration -Induced pluripotent stem cell differentiation into the cardiac lineage in response to electrical stimulation and media composition -Cell cultures of “normal” and cancer cells