



FACHHOCHSCHULE TRIER

Hochschule für Technik, Wirtschaft und Gestaltung
University of Applied Sciences



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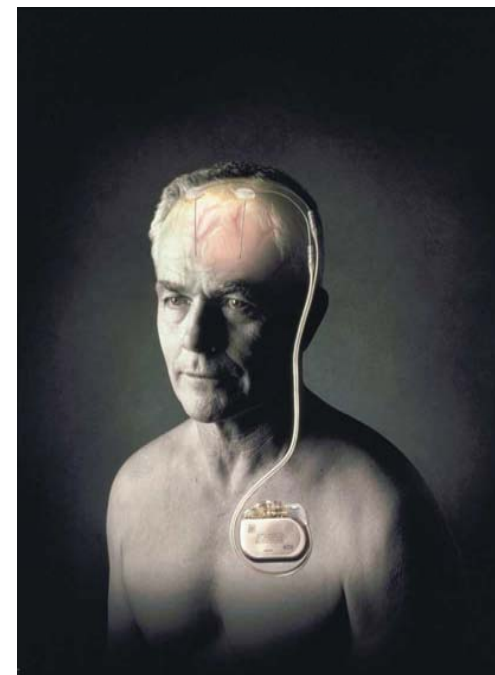
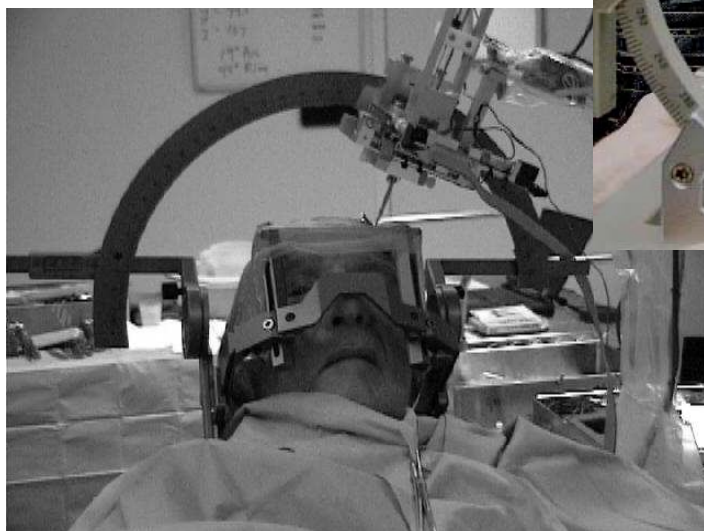
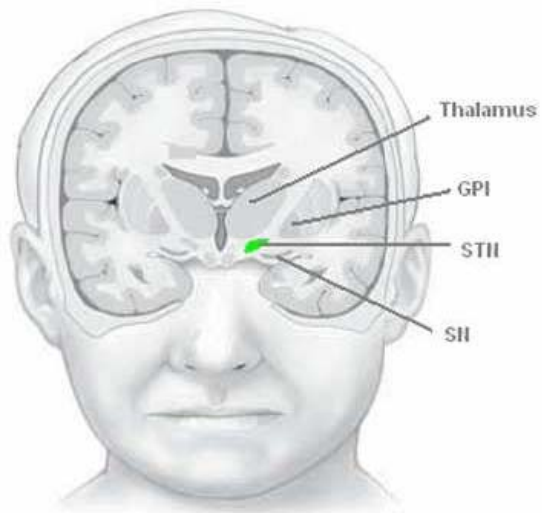
MER CLASSIFICATION FOR DEEP BRAIN STIMULATION

PETER GEMMAR

Stereotactic Deep Brain Stimulation



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Deep Brain Stimulation

Treatment of various neural diseases



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Common practice

- Parkinson (> 40.0000)
- Dystonia
- Cluster headache
- Various pain syndromes

Future applications?!

- Mental disorders
depression, obsessive
compulsive disorder

Increasing demand

- Aging of society





Workflow for stereotactic deep brain stimulation (technical view)

Planning

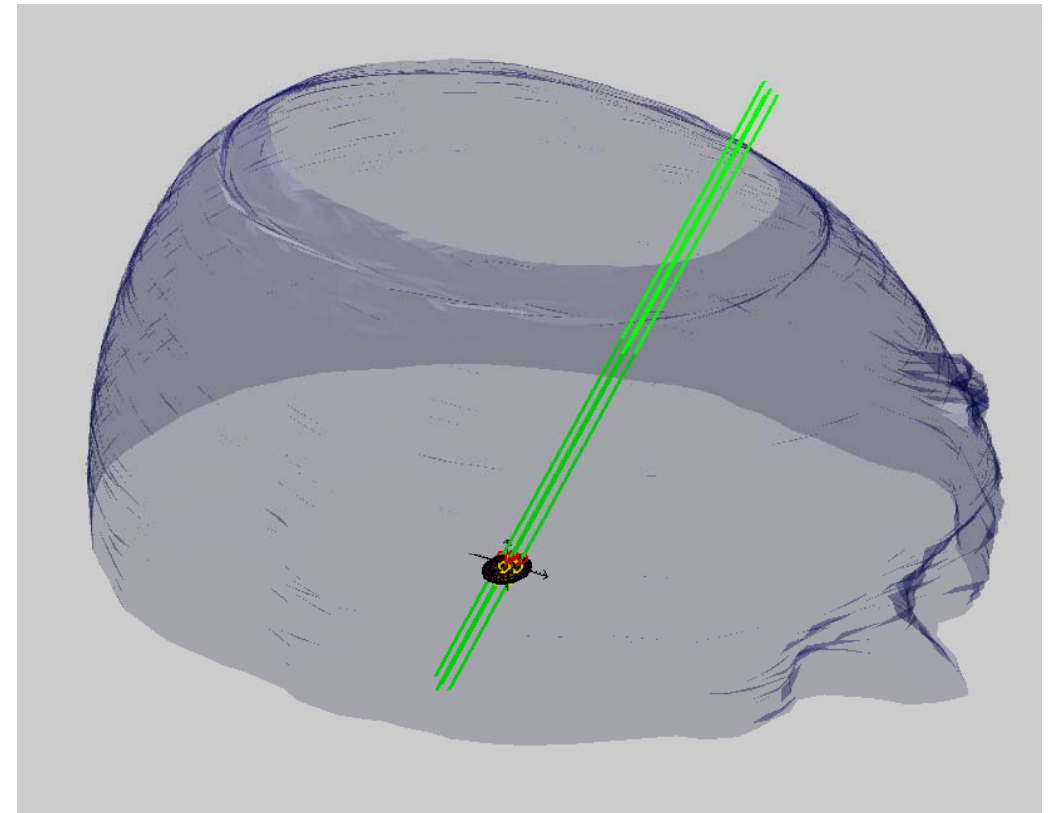
- Extraction of target points
- Selection of trajectories saving critical tissue

Navigation

- Nearing the target area
- Determining final position of the electrodes

Verification

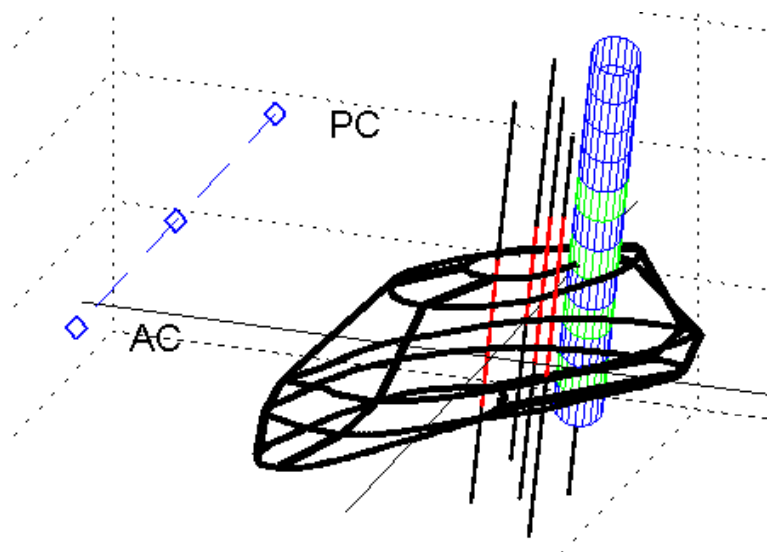
- Check and registration of electrode's position for post operative medical treatment



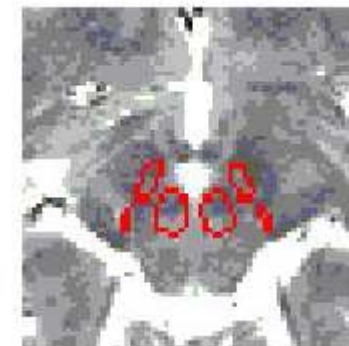
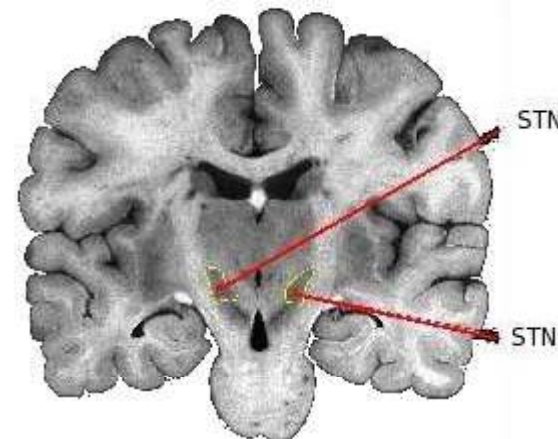
Requirements of Electrode Placement (error prone process steps)



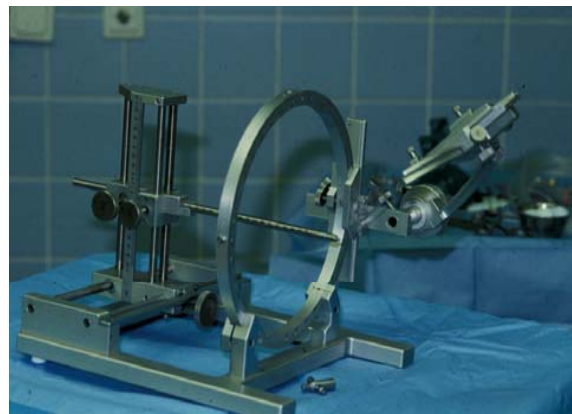
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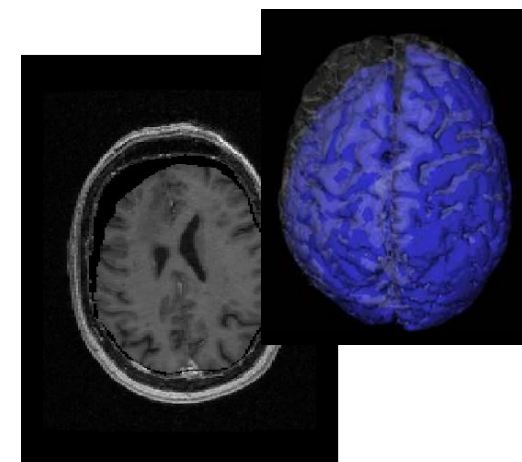
Precise target position!



Small target areas / difficult to locate



Limited mechanical accuracy

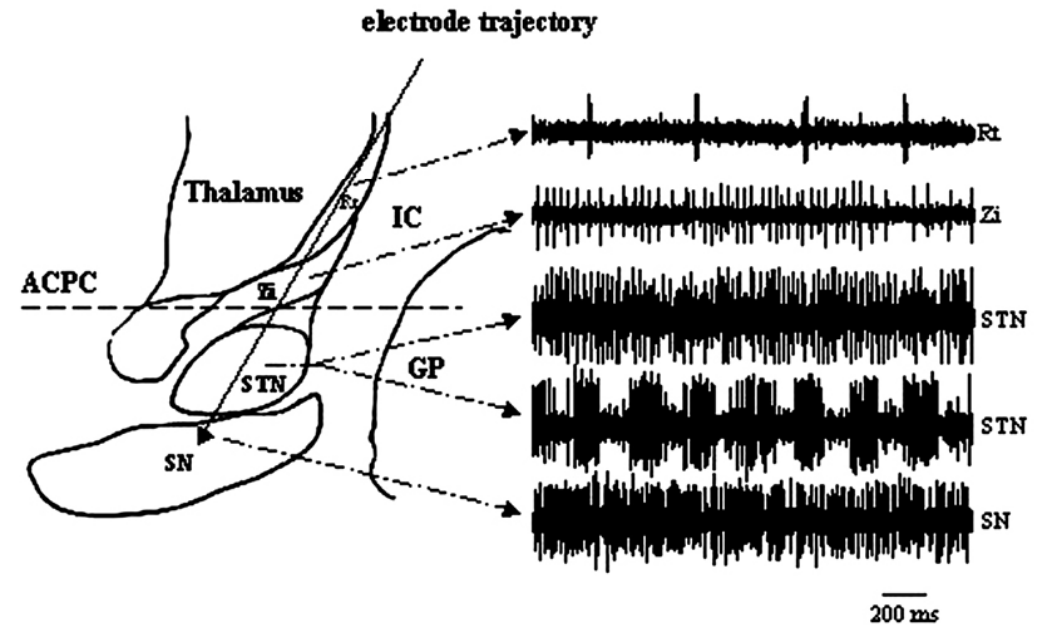


Brain shift

Process for optimized Electrode Placement



Target navigation using Microelectrode Recordings (MER)



Area-specific MERs along electrode's trajectory

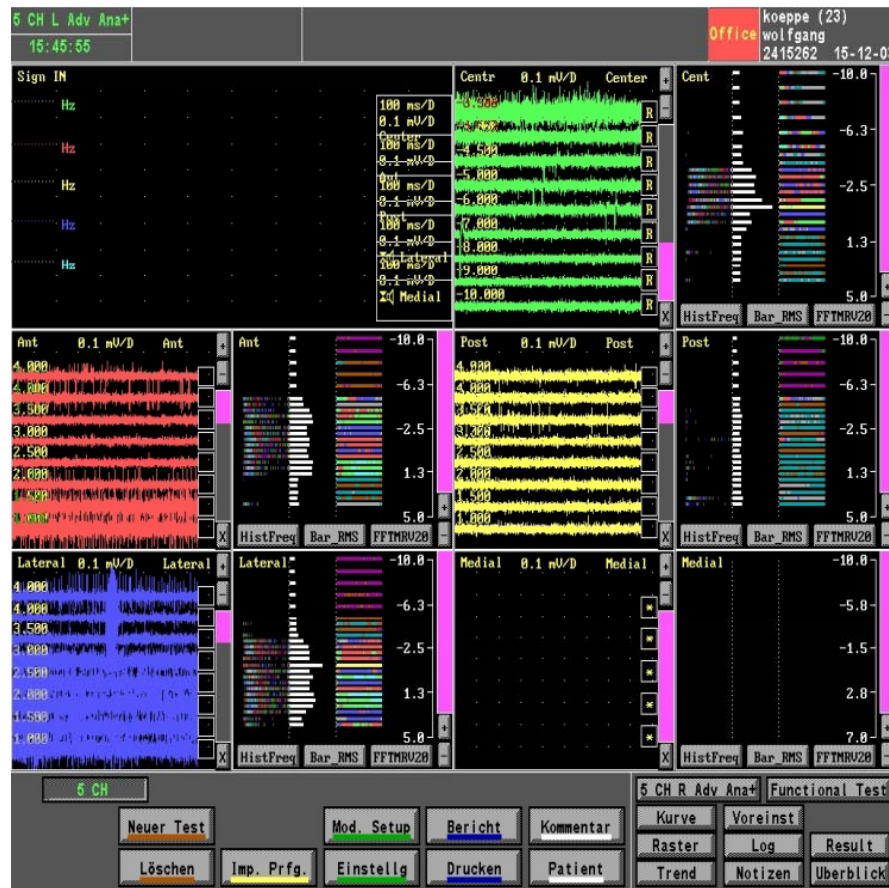


Microelectrode

MER for Target Navigation

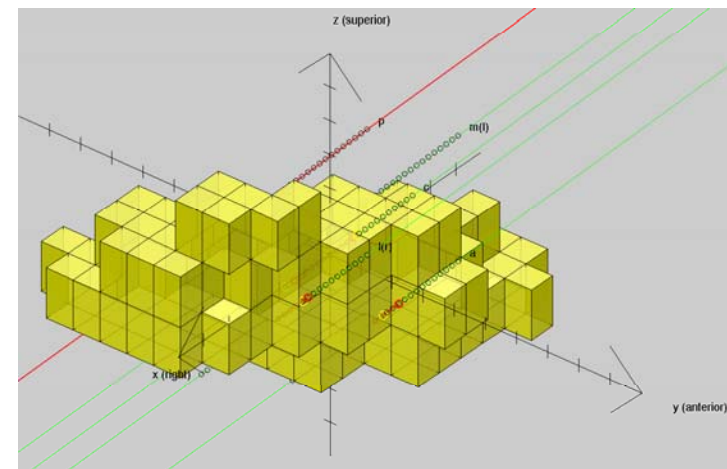


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Intra-operative Microelectrode Recordings (4 electrodes)

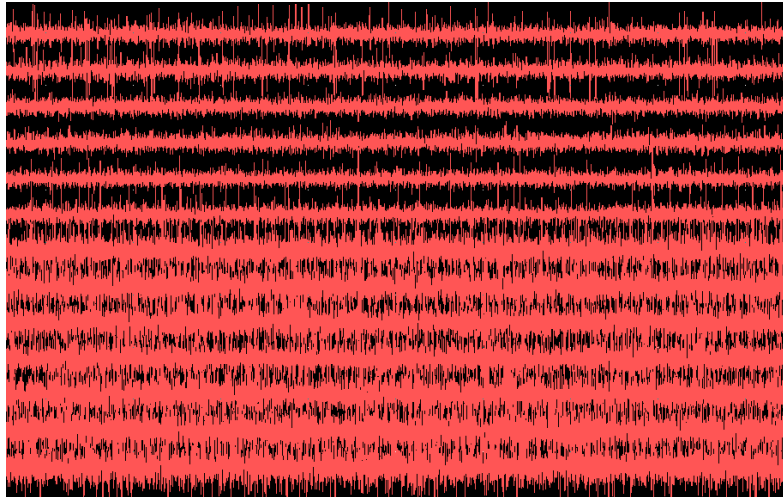
Microelectrodes passing STN (reconstruction from MER)



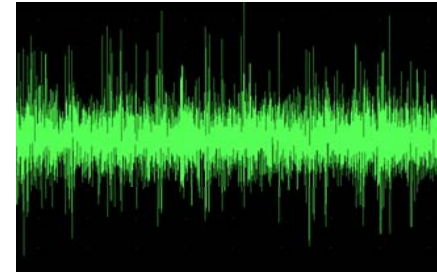
MER Classification (by surgeon)



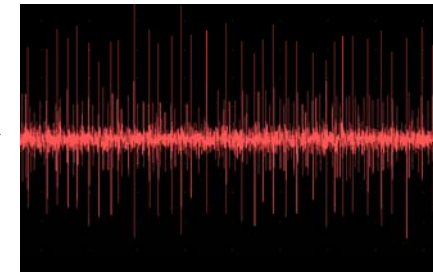
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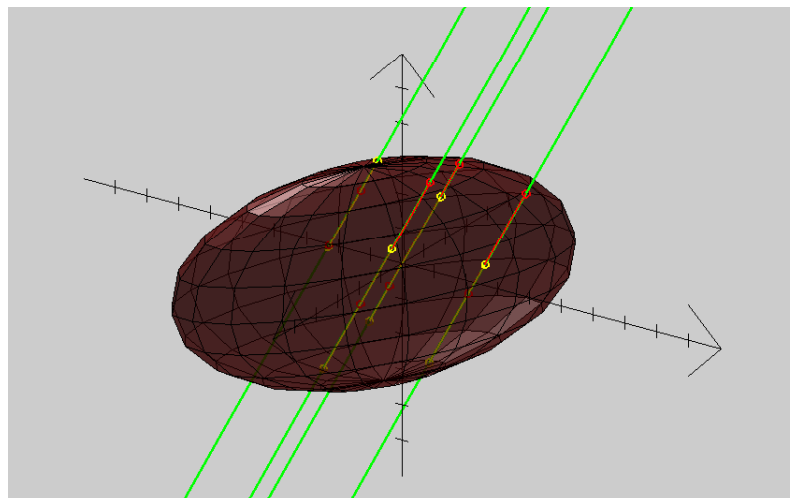
MER along electrode's trajectory



STN



SNr

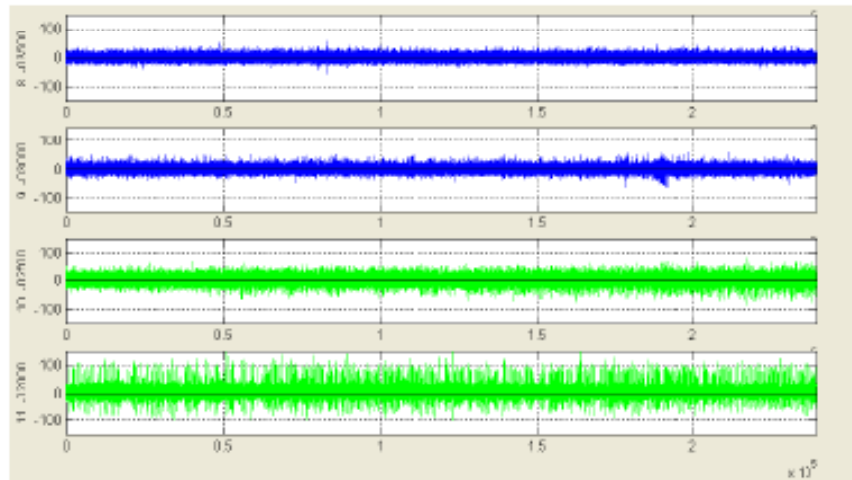


Electrodes intersecting target
(mental image)

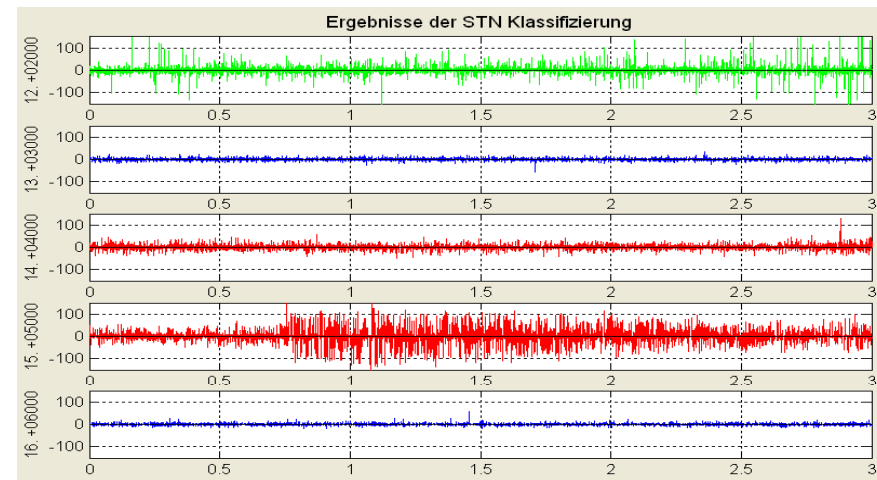
MER Classification Algorithm



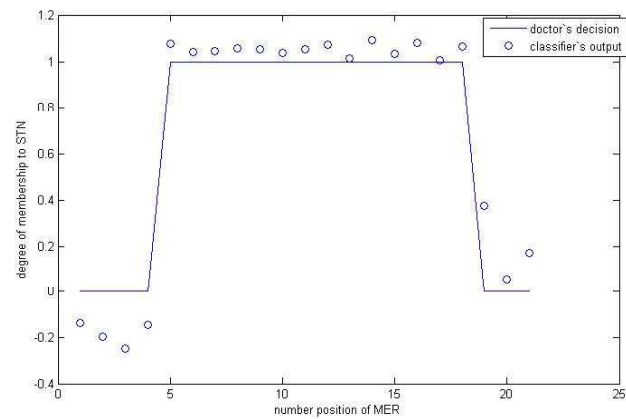
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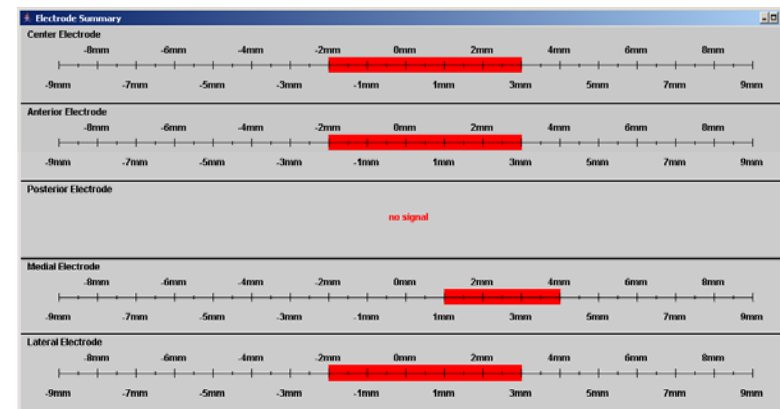
Raw MER



Classified MER



STN / non STN classification

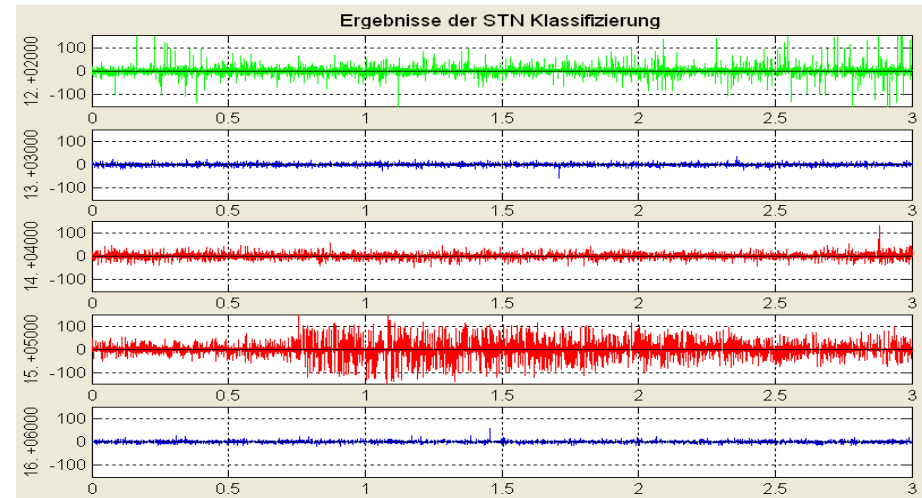


Classification results:
>95 % correct with 2434 MERs

MER – Algorithm: Classification and Visualization of electrode positions

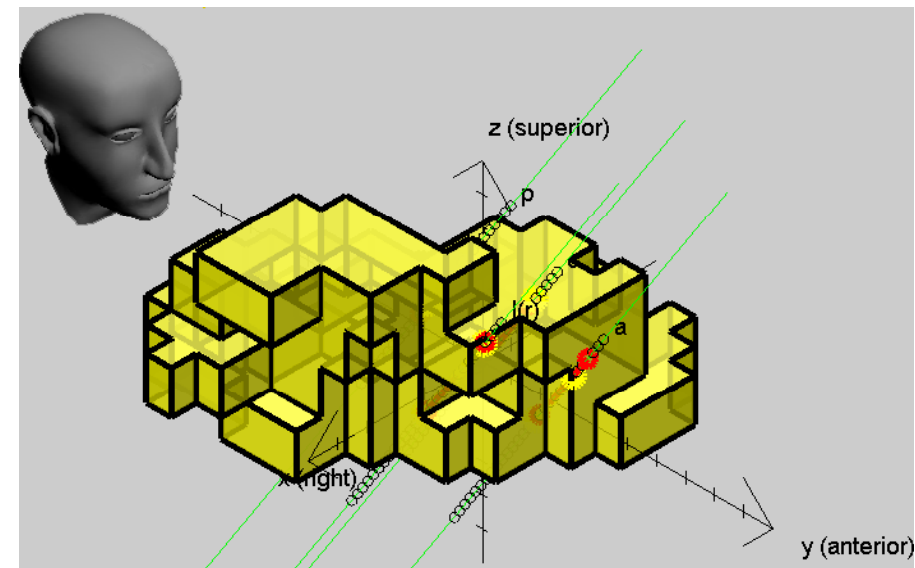
Identification of MER - signals

- Automatic classification of MER-signals:
green: STN,
red: non-STN,
blue: non neural area
- correct classification rate 94,45% (test with 2200 signals)



Visualization of electrode positions

- 3D-Registration of MER-data with STN-anatomy (STN-model or segmented STN)
- Visualizing of electrodes traversing surface of STN body to support optimal selection of final electrode (position)





Conclusion

- **DBS proven and promising therapy**
- **Increasing demand for treatment of neural diseases**
- **MER Classification / Computer assistance supports:**
 - standardization of surgery process**
 - therapy success**
 - cost reduction**

Software Developments Neuro Modulation – Deep Brain Stimulation



Cooperation Partner:
Dr. med. F. Hertel, Klinikum Idar Oberstein

Method and prototype development:
2004/2005

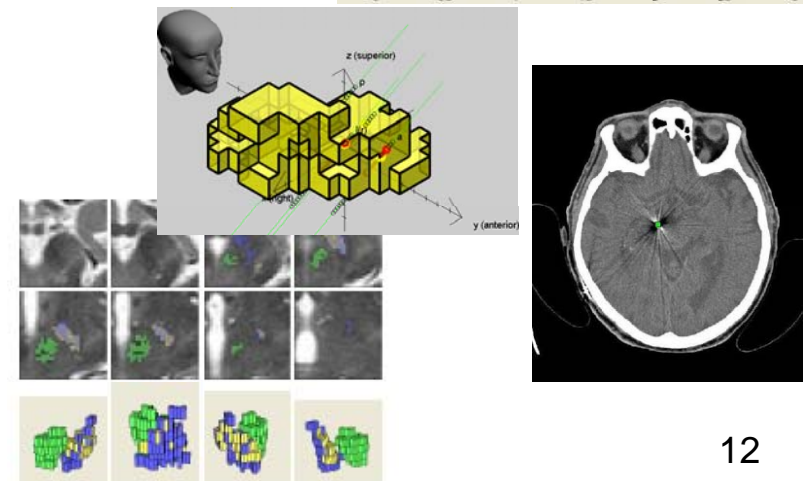
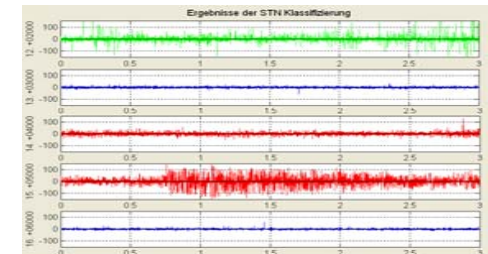
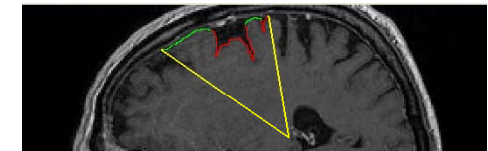
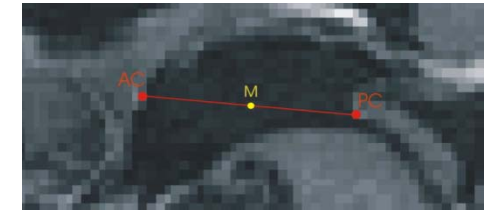
- Target Point Localization (AC-PC Detection)
 - Trajectory Planning
- (License transfer, Patent filing USA, 2006)

2006/2007

- MER Classification
- Registration of STN – Electrode Intersections
- CT-Artifact Reconstruction

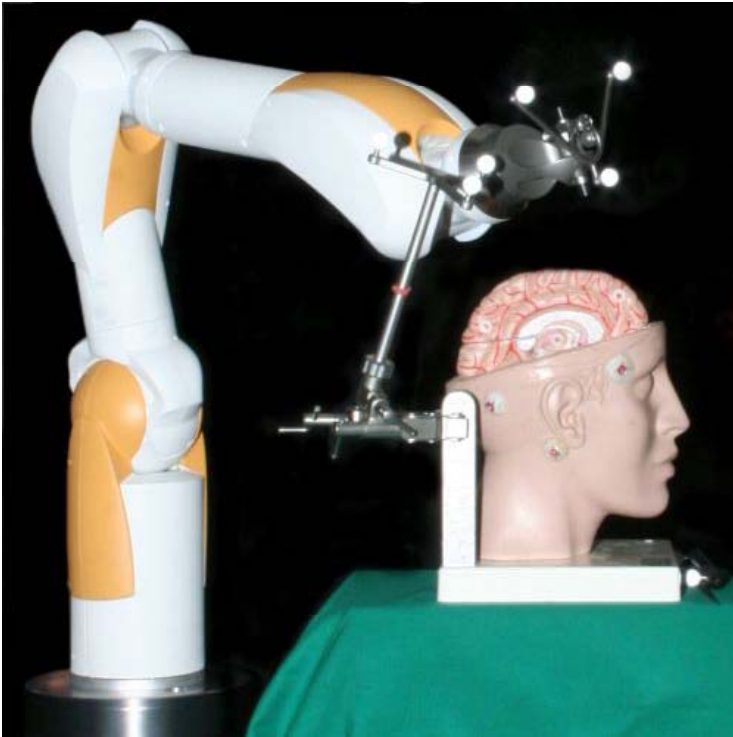
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- Segmentation of functional Areas in MRI /
Volume based Morphometrics



Requirements concerning the transfer business

- **We are looking for: Industry Partners**
- **We want to achieve:**
 - R&D Cooperation**
 - Development of the prototype ready for market**
 - Licensing or selling the prototype**



Vision?
(Curac 2007)



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