### Aplikace umělé inteligence v medicíně

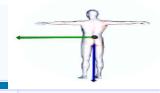
**Daniel Novák** 

8.3.2012 Asistivni technologie





### Outline



- OLDES: Older People's e-services at home
- Single DBS Neuron Processing
- Eye Movement Analysis: Slow Phase Velocity (expert systems)

### Robotická chirurgie

- Bipolar & Schizophrenia Analysis
- Sleep Quality Analysis and Apnea Detection
- MRI Spectroscopy Data Analysis
- Postural Analysis & Rehabilitation
- Lower Body Negative Pressure
- Spiro-ergometric Data Analysis Activity Monitoring: Fall Detection
- Motivated Rehabilitation
- Eye Movement Analysis: Dyslexia analysis





## **OLDES**

### **Older People's e-services at home**

### People:

Prof. Olga Stepankova, Daniel Novak, Petr Novak, Vratislav Fabian, Karel Maly, Jan Hrdlicka, Martin Janouch, Lenka Novakova III. Interni klinika, Vseobecna nemocnice: Doc. MUDr. Martin Haluzik, MUDr. Milos Mraz, MUDr. Miroslav Kremen, MUDr. Tomas Roubicek, Jan Padera (DP)

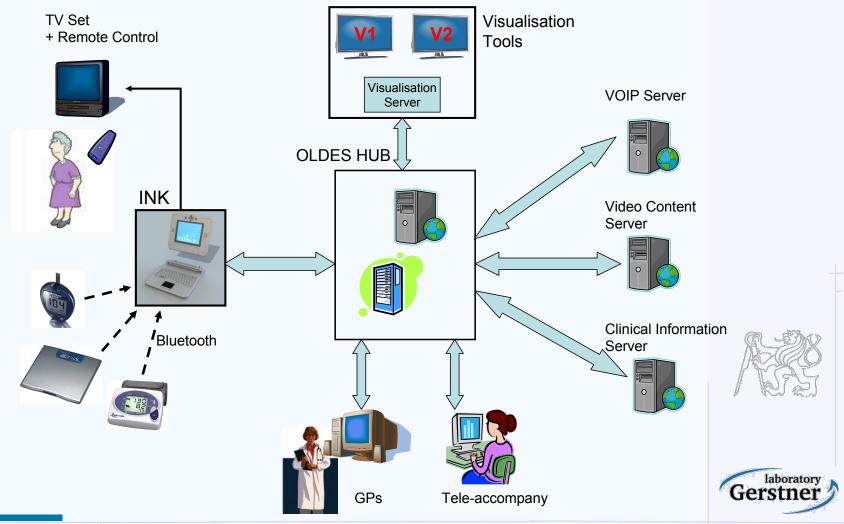


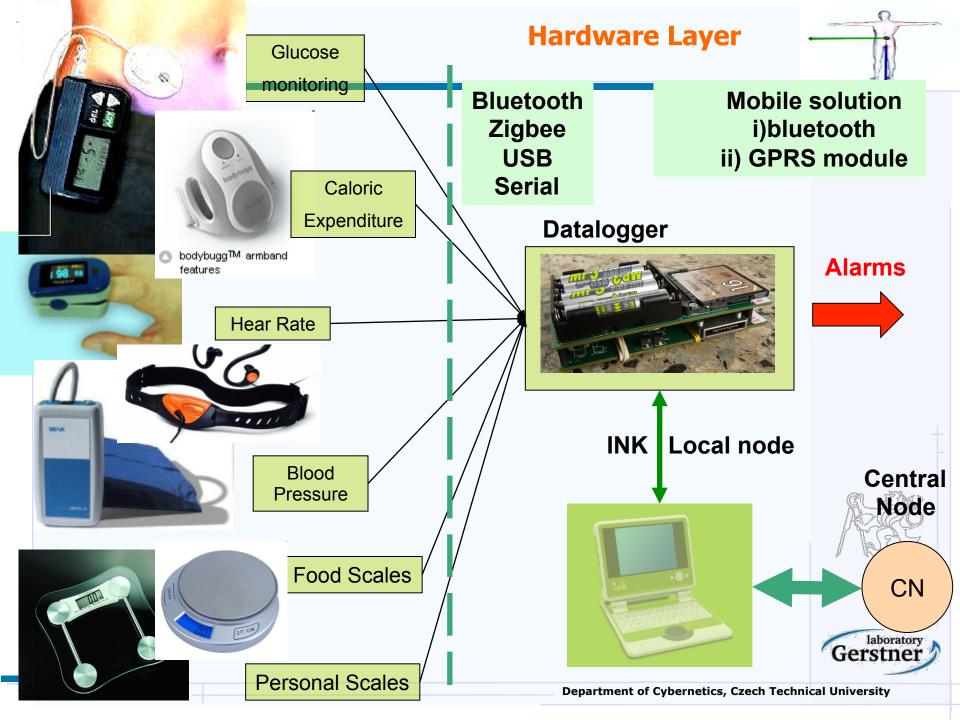
Area: Asistive Ambient Living, Applied Gerontology

Goal: Diabete project: Glycemia prediction, User Interface Development Debartment of Cybernetics, Czech Technical University



## **Demonstrator Architecture**





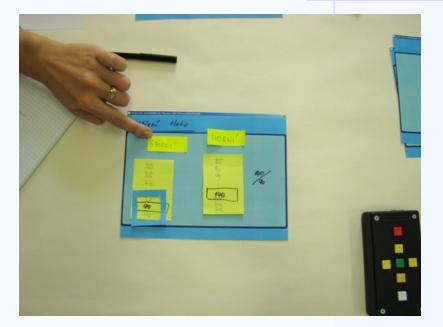




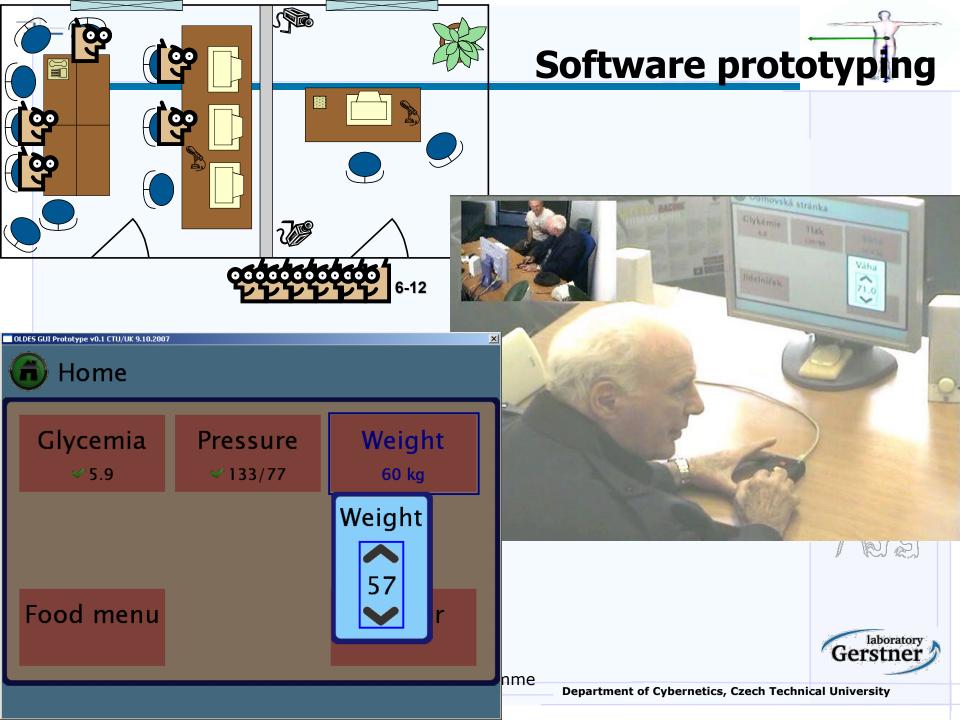
# **Paper prototyping**



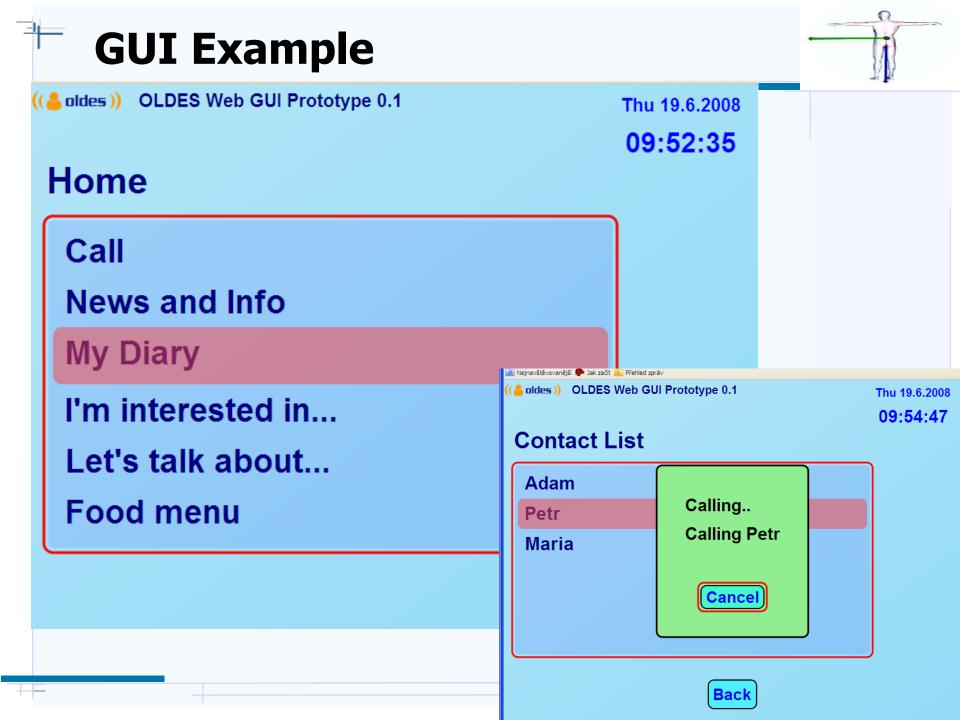




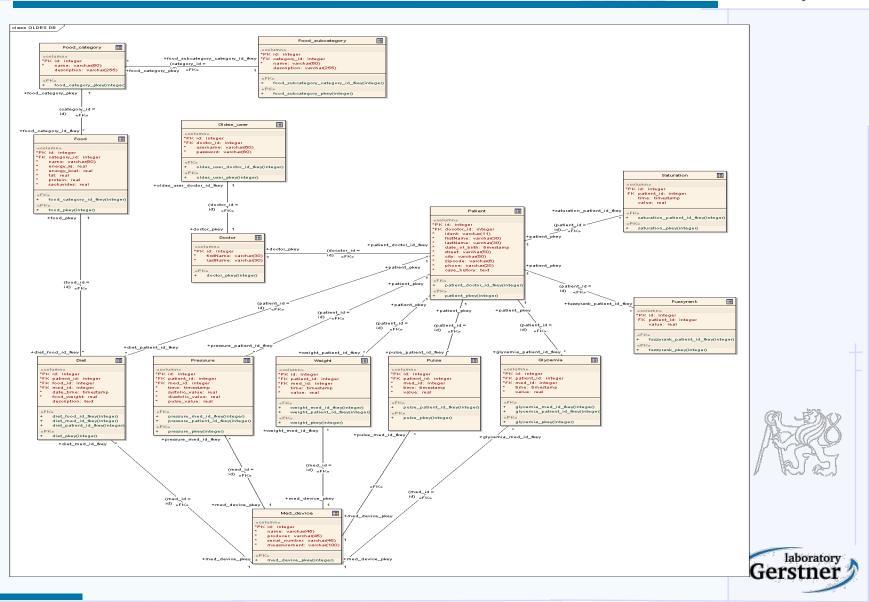




### **Tangible User Interface Design Evolution** TOP TOP TOP TOP OK → OK ← <u>OK</u> → ← OK BACK BACK BACK OX Weemote atory 1**er** D



## CI: OLDES DB



Q

### Single DBS Neuron Processing

#### People: Daniel Novak, Prof. O.Stepankova, 1.UK, Nemocnice Homolka: MUDr. Robert Jech PhD, MUDr., Karel Schmidt (DP), Bc. Jiri Wild (DP), Bc. Pavel Neuschl (DP)



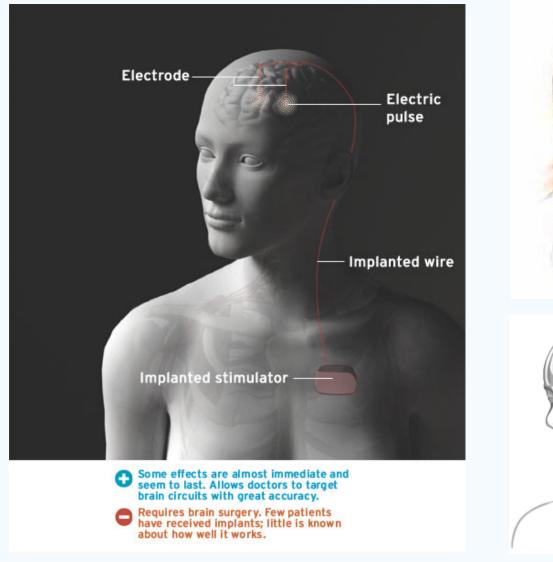
#### **Goal: Do Neurons in Basal Ganglia Respond to Emotional Content?** *i*erstn

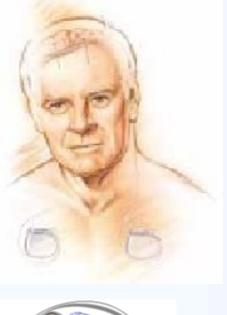
Department of Cybernetics, Czech Technical University

laboratory

DBS







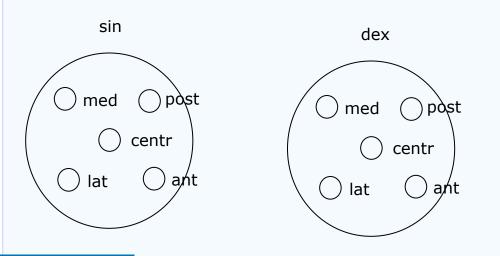


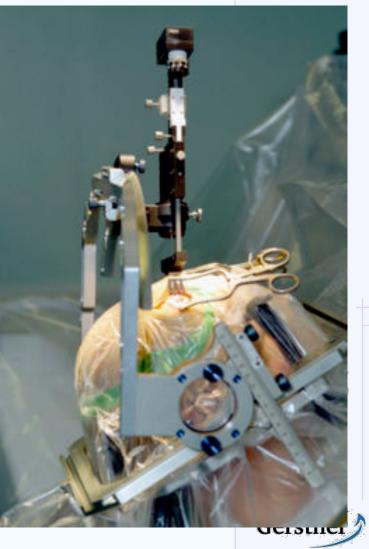




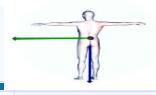
#### How: Functional stereotactic neurosurgery

- Surgery at sites deep within the brain utilizing a stereotactic frame and stereotactic coordinates.
- Used for making a lesion or implanting a DBS electrode in thalamus or basal ganglia for treatment of movement disorders (PD, dystonia, ET), pain, etc.

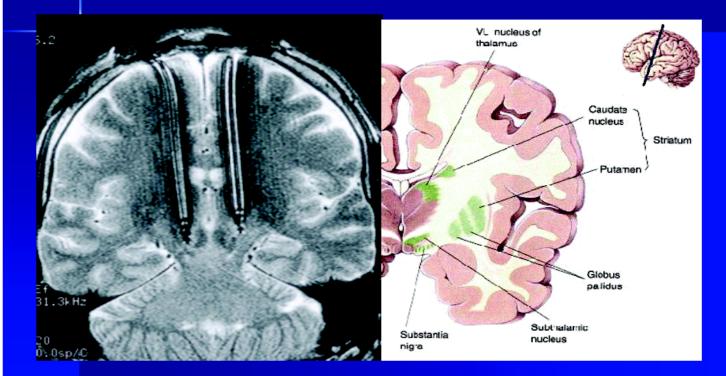




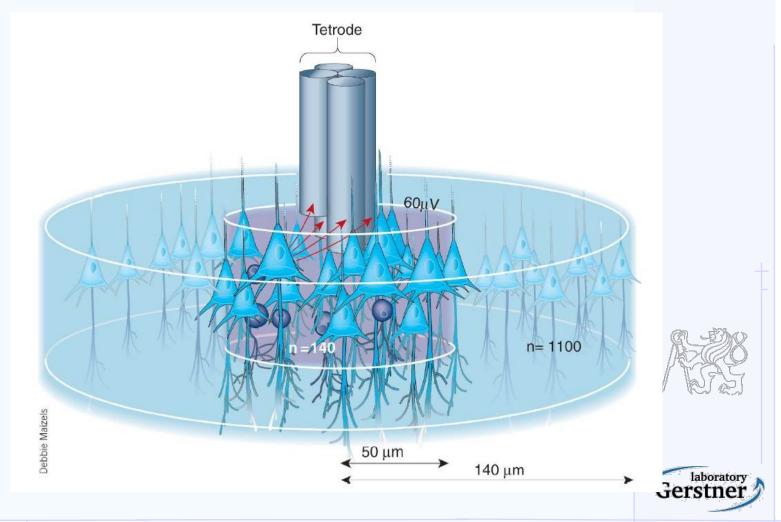




### DBS: Topography



## **Neuron single action potential**



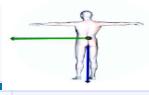


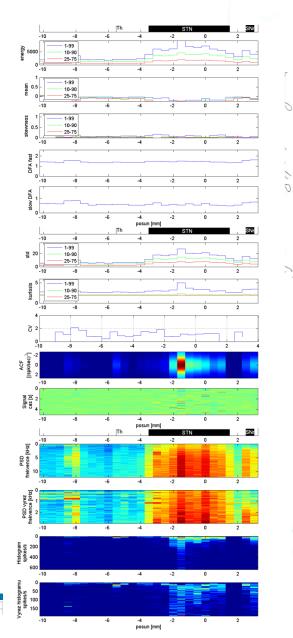
#### 3)Visualization of navigation – raw parameters

i'l plan

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	Center EL	Anterior EL	Posterior EL	Medial EL	Lateral EL	DBS Lead Position
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Micro electrode recording: DATE: 14/3/06

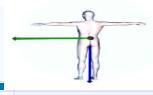
# Annotation Surgery protocol



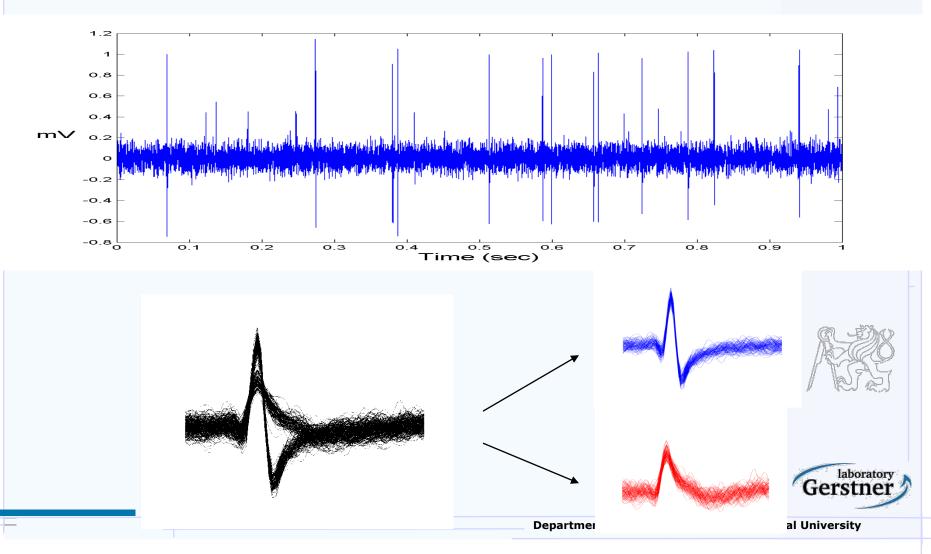
Gerstner

s, Czech Technical University

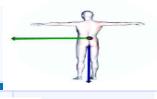
#### Main Idea

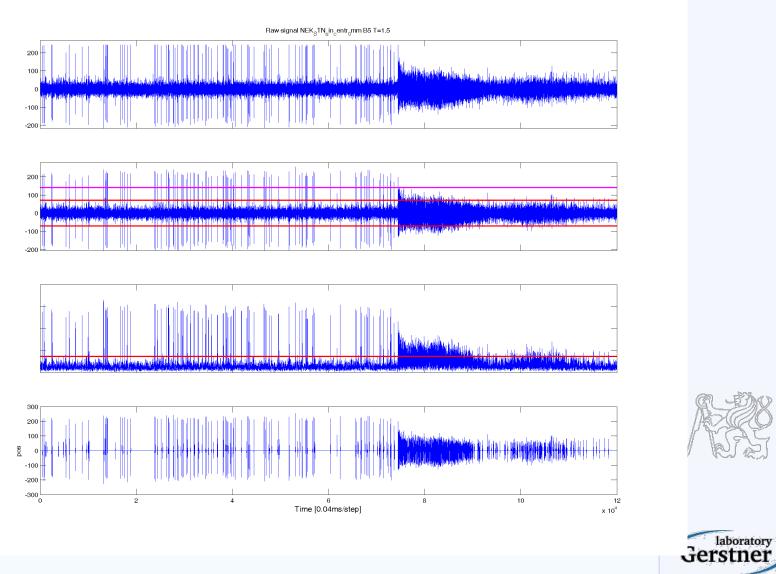


- Motivation
  - Assign stimuli (picture, sound, movement) to different neurons !!!

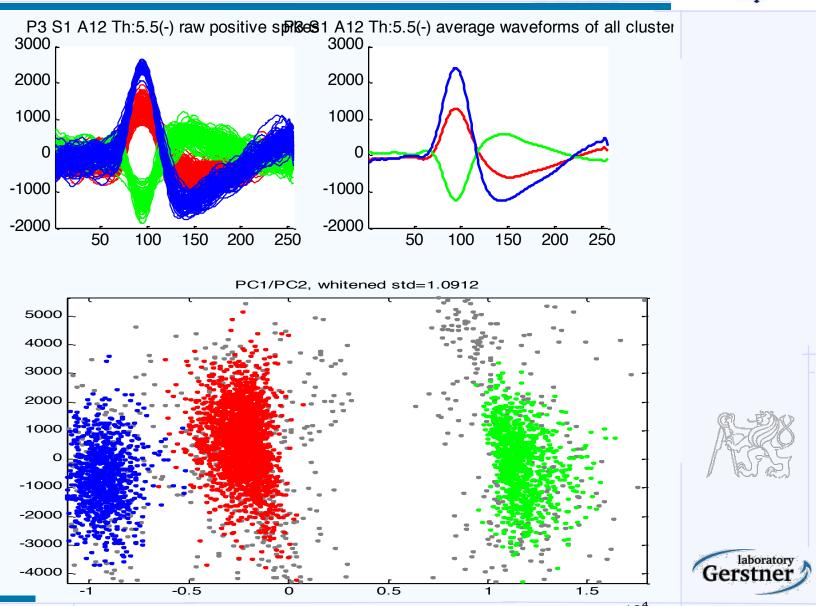


#### **Spike Detection**

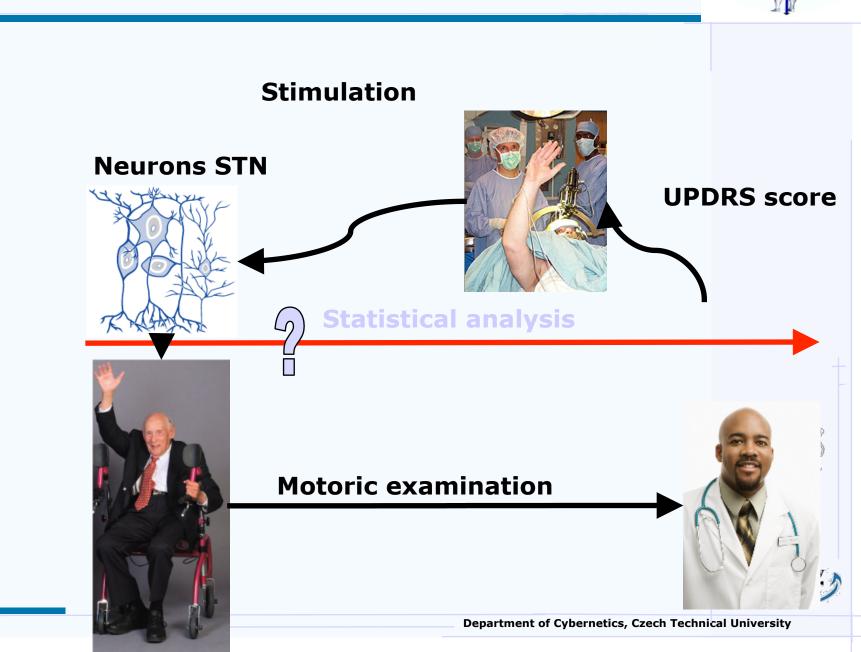




#### Spike Sorting: one channel, 3 cluster, PCA projection



### **Dependence UPDRS or depression?**



# **IAPS experiment**

- affective visual stimulation
- a series of 24 IAPS pictures



#### MicroEEG Data Recording

- peroperative STN exploration
  - integral part of DBS implantation
- 5 parallel microelectrodes
- sampling at 24kHz



- 10 patients
- 43 recording positions
- 141 recordings (74 from STN)
- 173 minutes (89 from STN)
- 176 neurons (101 in STN)





baseline 2







presentation for 2s + 2s

recording during presentation

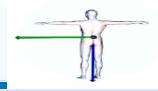
stimulation 1

- pseudorandom ISIs
- pseudorandom picture emotional content
- uniqueness

baseline 1



rsity



## Bipolar & Schizophrenia Analysis

People:

Daniel Novak, Ing. Jan Hrdlicka (PhD), Katerina Sedlackova (DP), Jan Poupe (DP), Radek Jedlicka (BP), **PPC:** MUDr. Filip Spanel PhD, **EPSA:** (Dr. David Cuesta Frau)

Area: Biological Signal Processing, Temporal Pattern Recognition, Multivariate Time Series Classification

> **Goal: Schizophrenia Relapse Prediction, Prediction of Mania and Depressive states**



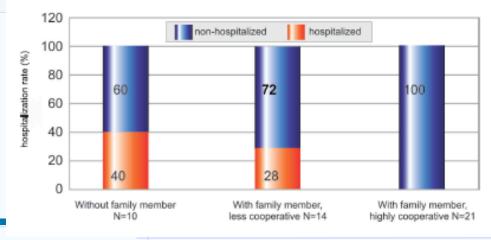
laboratory



### TAREPS

PROGRAM PREVENCE RELAPSU PSYCHOTICKÉHO ONEMOCNĚNÍ

Fig. 1: HOSPITALIZATION RATE AND ADHERENCE TO THE ITAREPS PROTOCOL. CUT OFF POINT OF COOPERATIVENESS DEFINED AS MORE OR LESS THEN 70 % OF REQUIRED EWSQ QUESTIONNAIRES RETURNED



POČITAČ ANTOMATICKY VýHODNOCUJE BRÓRE DOTAZNÍNÍ, HA BRÝCH OBOBNICH HITERNETOVÝCH BIRÁNKÁCH LÉKAŘ HALEZNE ARTHÁLNÍ HIFORMACE O BTAVU PACIENTA V GRAFICKÉ I BLONIÍ PODOBĚ,

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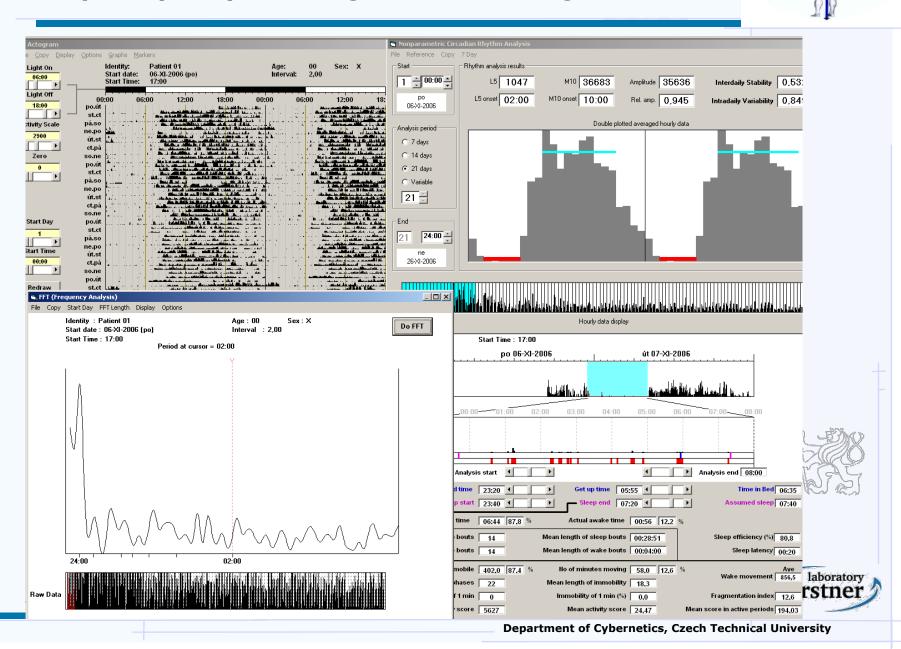


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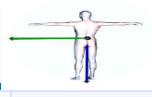
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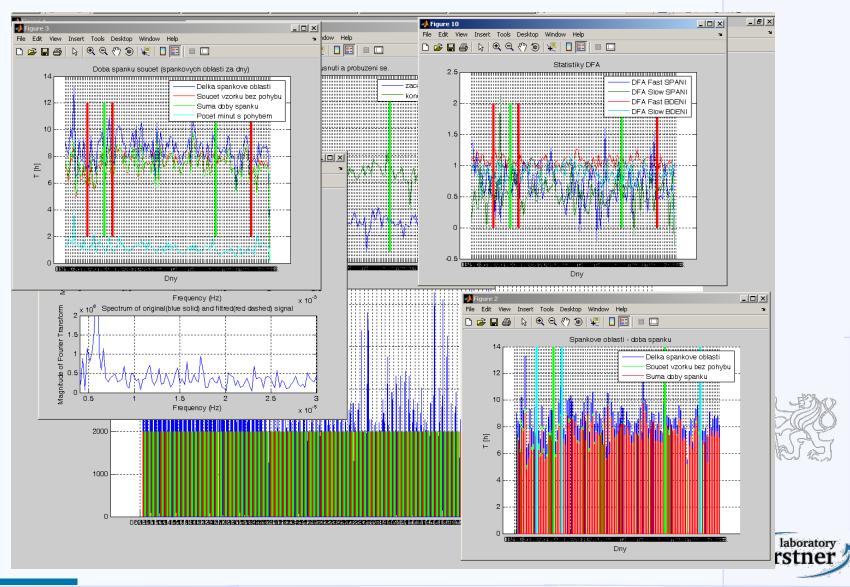
INFORMACI O Z MĚNĚ BTAVU PACIENTA

#### **Sleep Analysis by Cambridge Neurotechnologies**



**Sleep analysis** 









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