

Aplikace umělé inteligence v medicíně

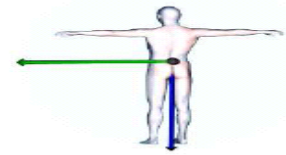
Daniel Novák

8.3.2012

Asistivní technologie

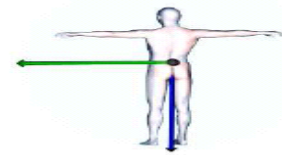


Outline



- 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:

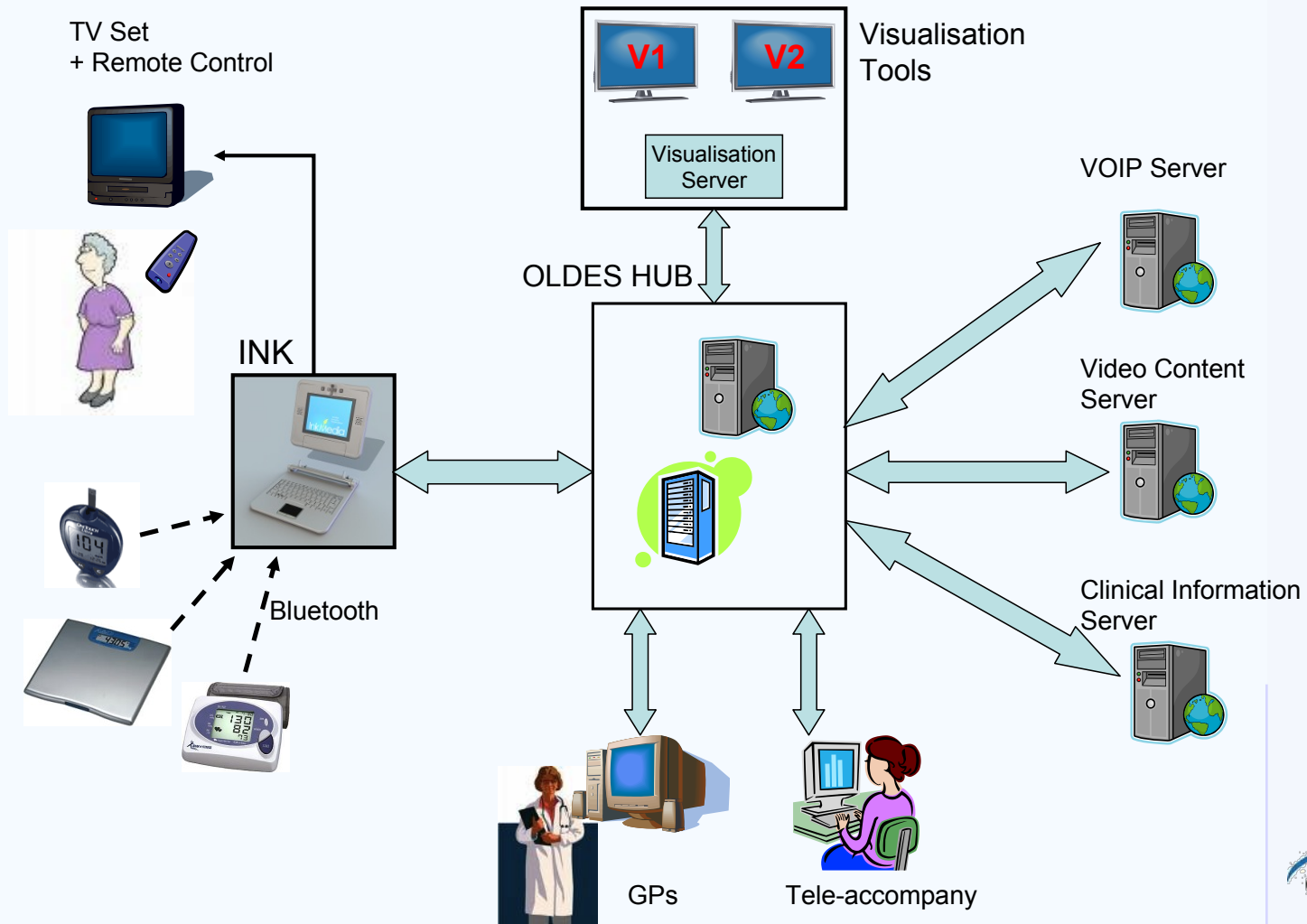
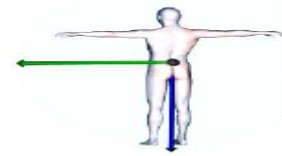
Prof. Olga Stepankova, Daniel Novak, Petr Novak, Vratislav Fabian, Karel Maly, Jan Hrdlicka, Martin Janouch, Lenka Novakova **III. Interni klinika, Vseobecna nemocnice**: Doc. MUDr. Martin Haluzik, MUDr. Milos Mraz, MUDr. Miroslav Kremen, MUDr. Tomas Roubicek, Jan Padera (DP)

Area: Asistive Ambient Living, Applied Gerontology

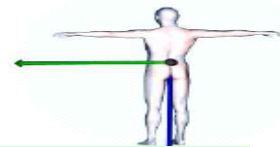
**Goal: Diabete project: Glycemia prediction,
User Interface Development**



Demonstrator Architecture



Hardware Layer



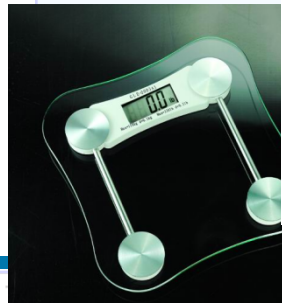
Glucose monitoring



Hear Rate



Blood Pressure



Personal Scales



Food Scales



Caloric Expenditure

bodybugg™ armband features

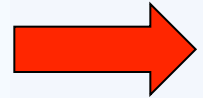
Bluetooth
Zigbee
USB
Serial

Mobile solution
i) bluetooth
ii) GPRS module

Datalogger



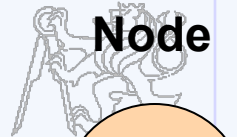
Alarms



INK Local node



Central Node



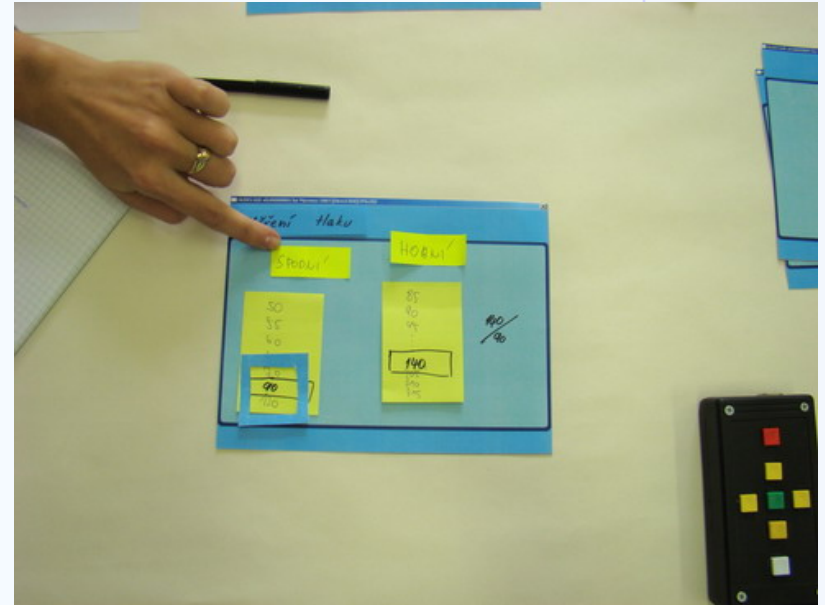
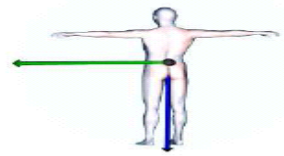
CN



ink

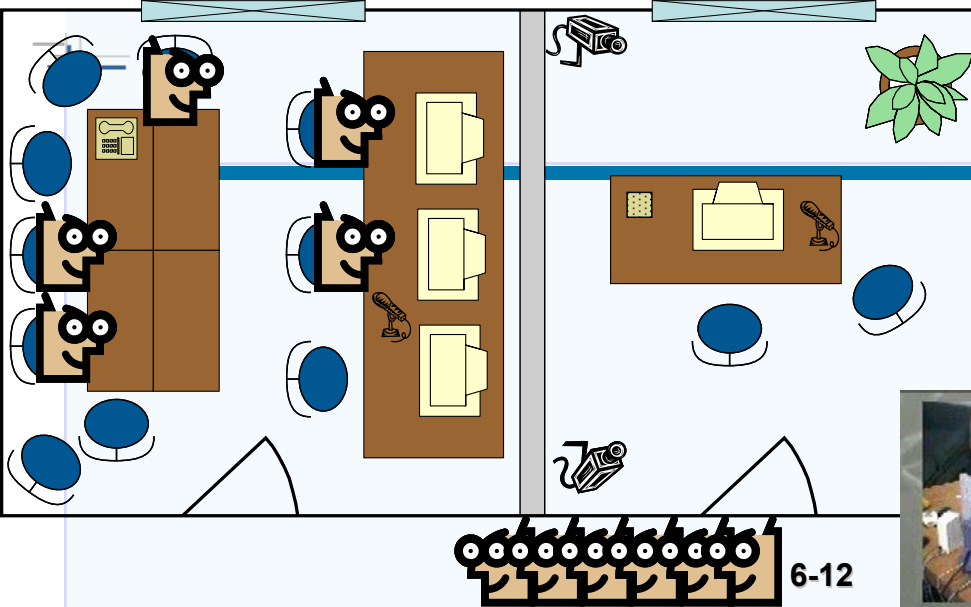
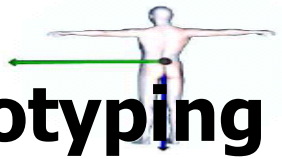


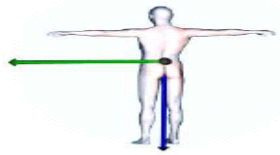
Paper prototyping



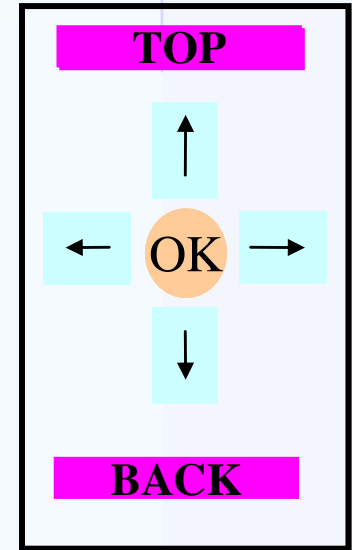
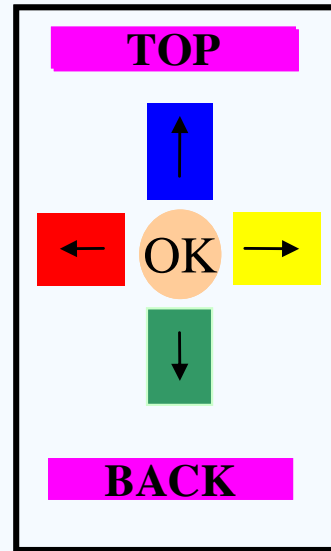
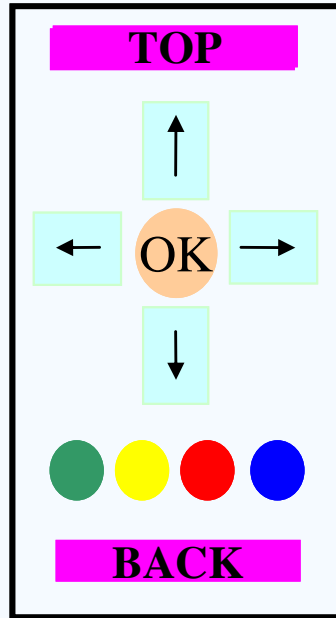
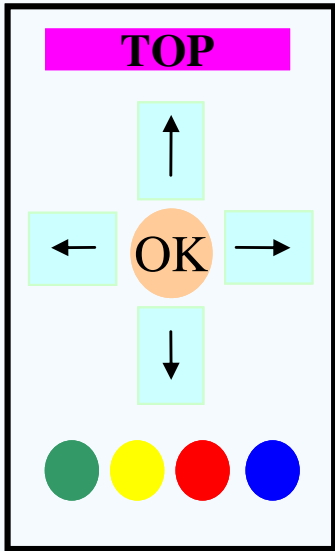
IST Programme

Software prototyping

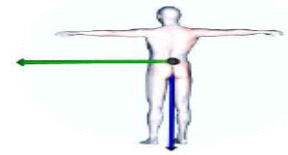




Tangible User Interface Design Evolution



GUI Example



((oldes)) OLDES Web GUI Prototype 0.1

Thu 19.6.2008

09:52:35

Home

Call

News and Info

My Diary

I'm interested in...

Let's talk about...

Food menu

Nejnavštěvovanější Jak začít Přehled zpráv

((oldes)) OLDES Web GUI Prototype 0.1

Thu 19.6.2008

09:54:47

Contact List

Adam

Petr

Maria

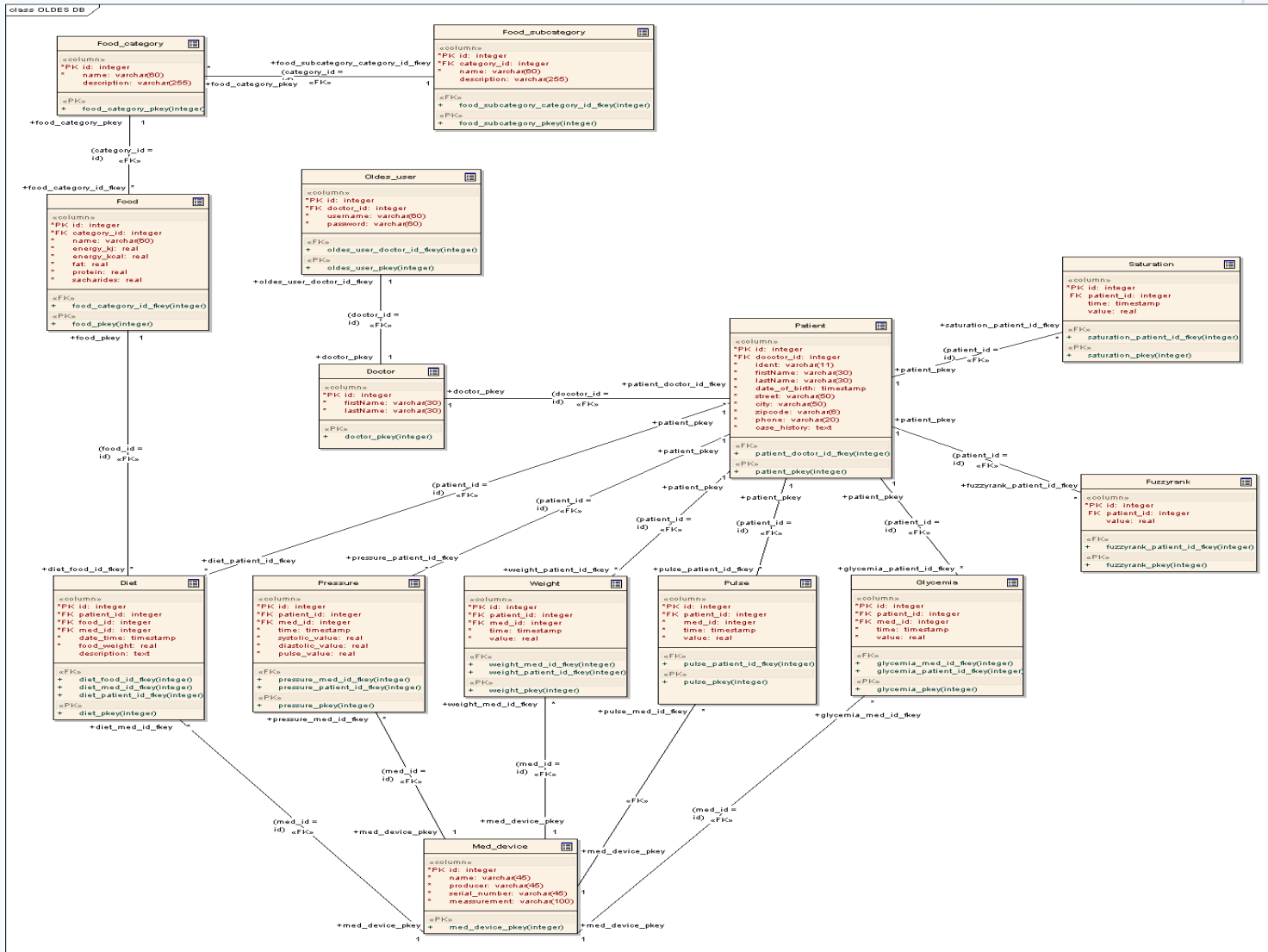
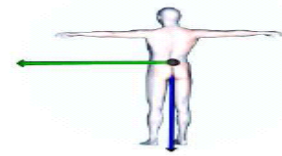
Calling..

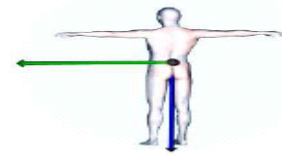
Calling Petr

Cancel

Back

CI: OLDES DB





Single DBS Neuron Processing

People:

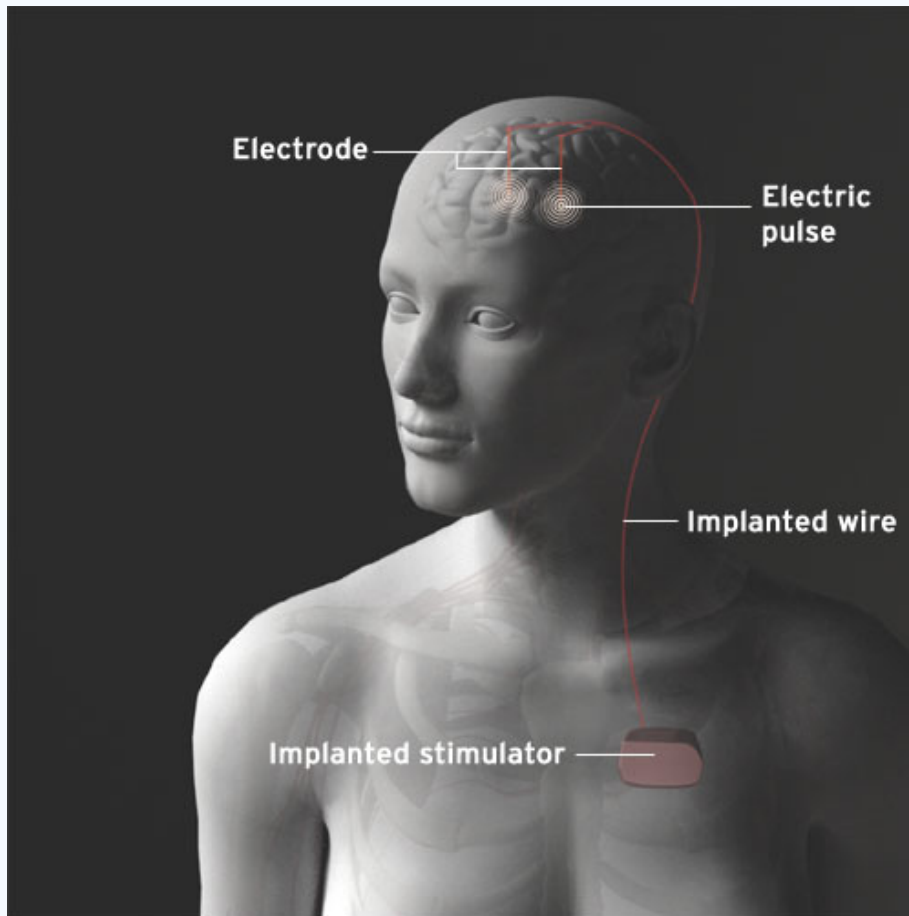
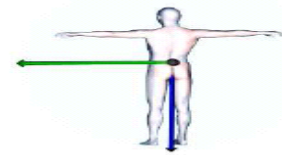
Daniel Novak, Prof. O. Stepankova, **1.UK, Nemocnice Homolka:**
MUDr. Robert Jech PhD, MUDr., Karel Schmidt (DP), Bc. Jiri Wild (DP),
Bc. Pavel Neuschl (DP)

Area: Biological Signal Processing

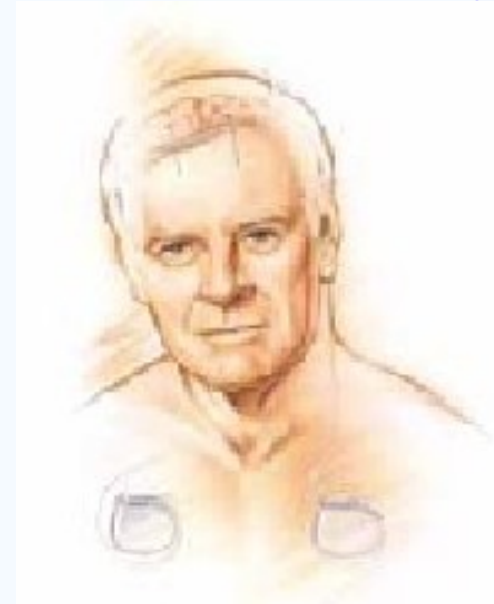
Goal: Do Neurons in Basal Ganglia Respond to Emotional Content?

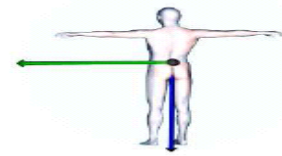


DBS



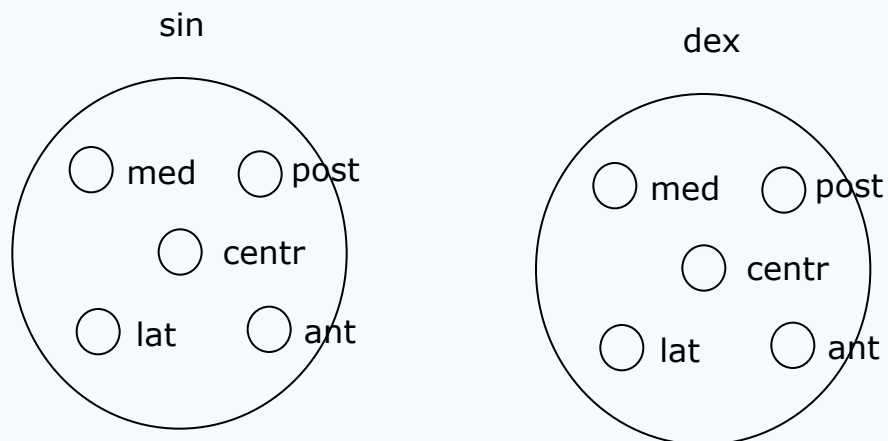
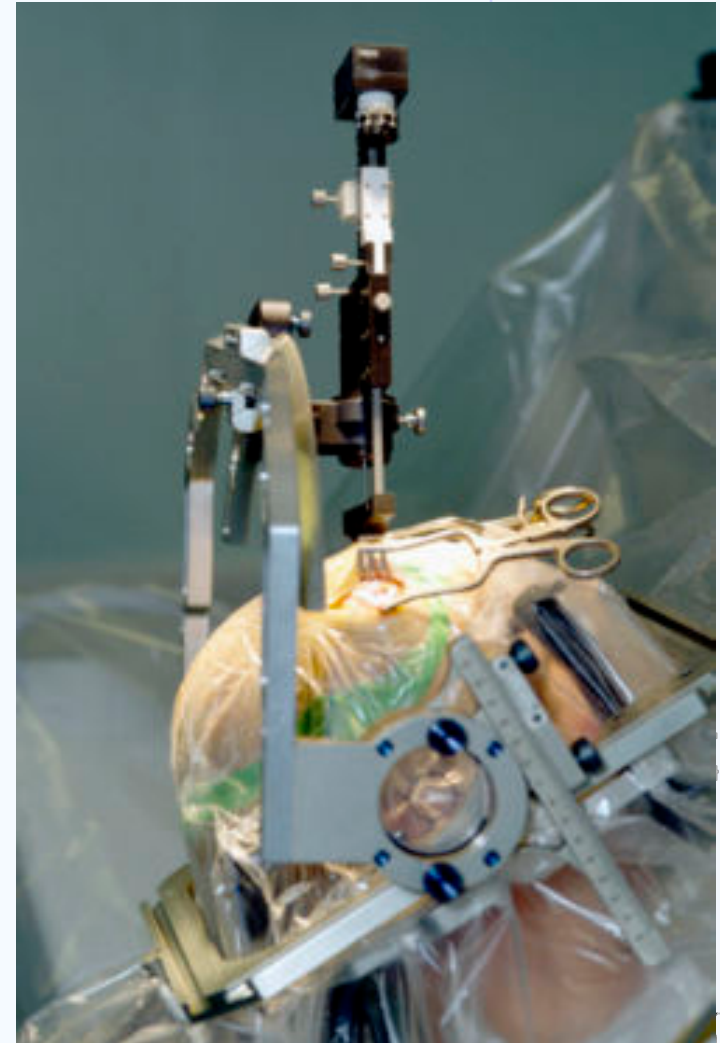
- + Some effects are almost immediate and seem to last. Allows doctors to target brain circuits with great accuracy.
- Requires brain surgery. Few patients have received implants; little is known about how well it works.

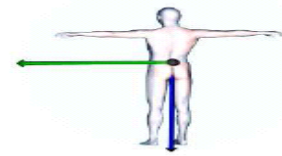




How: Functional stereotactic neurosurgery

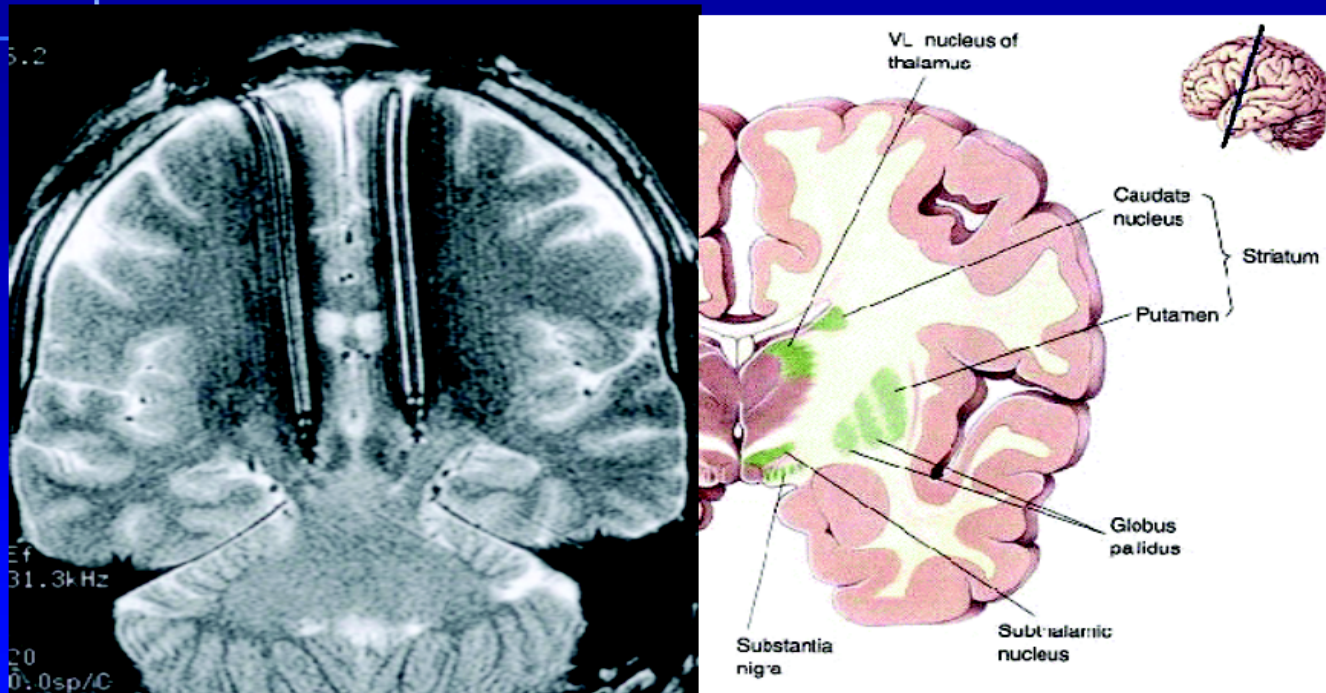
- Surgery at sites deep within the brain utilizing a stereotactic frame and stereotactic coordinates.
- Used for making a lesion or implanting a DBS electrode in thalamus or basal ganglia for treatment of movement disorders (PD, dystonia, ET), pain, etc.



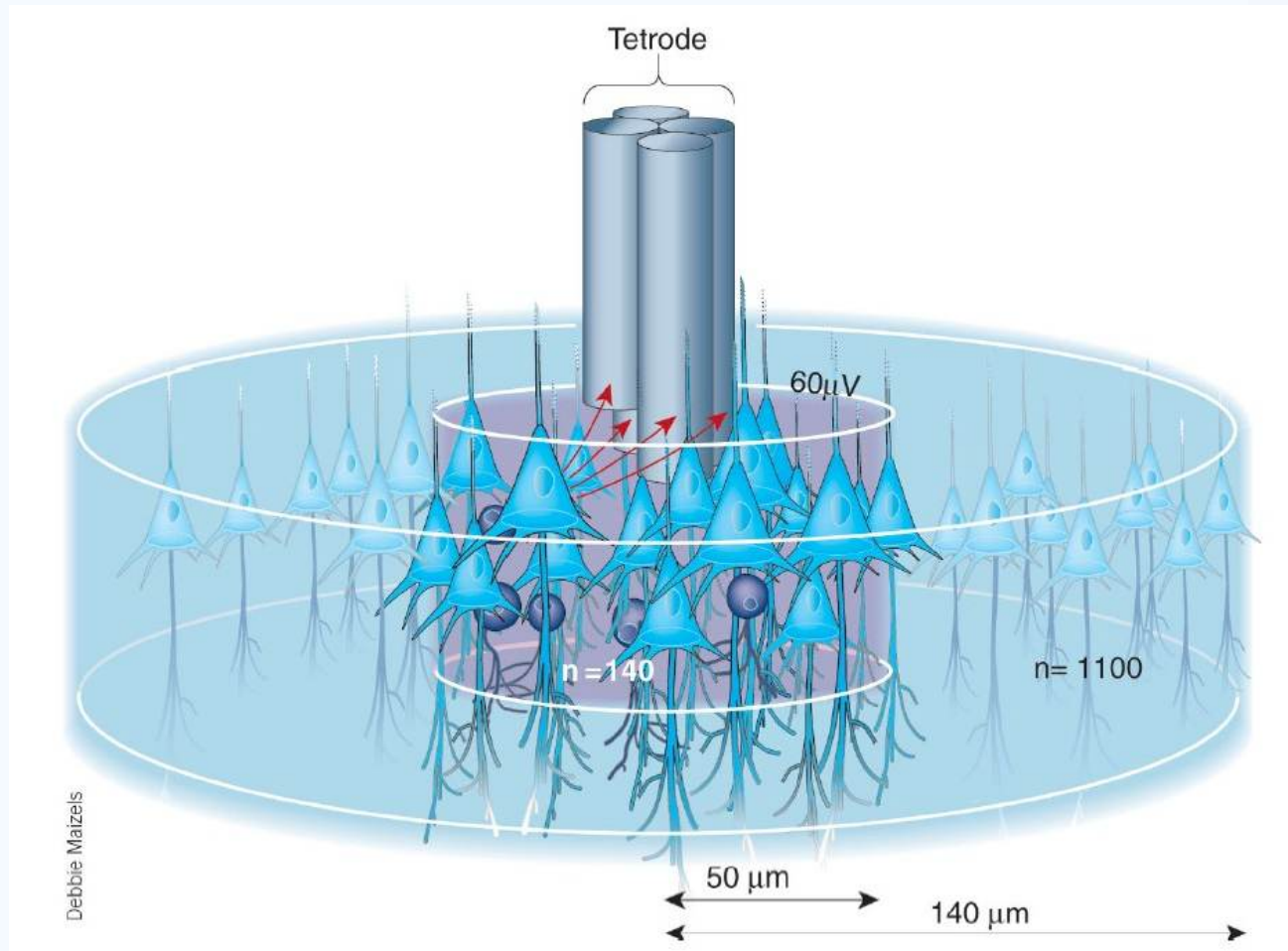
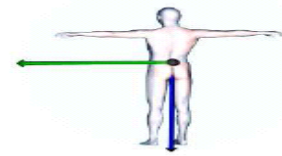


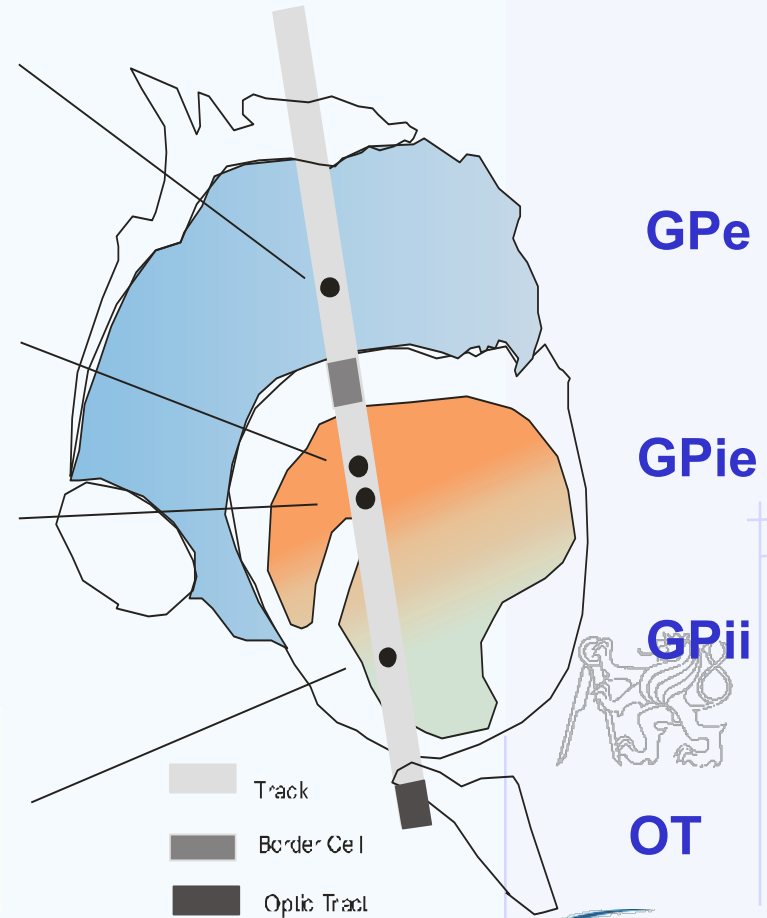
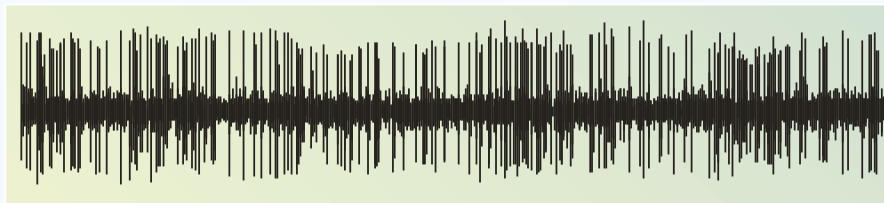
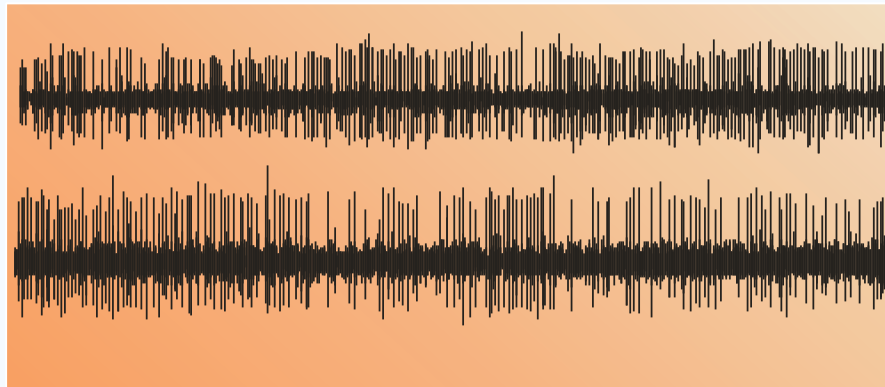
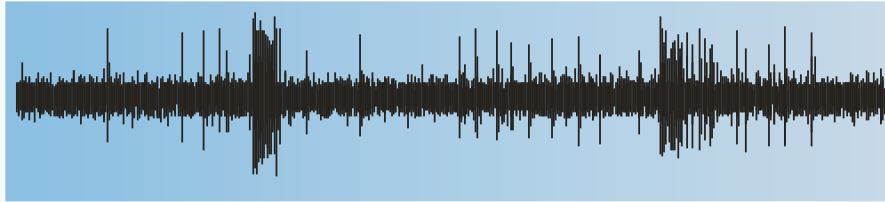
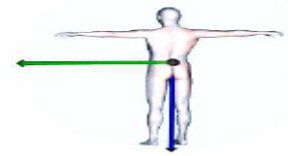
DBS: Topography

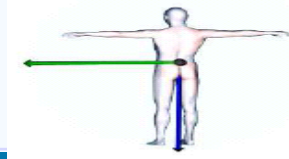
DBS: Topography



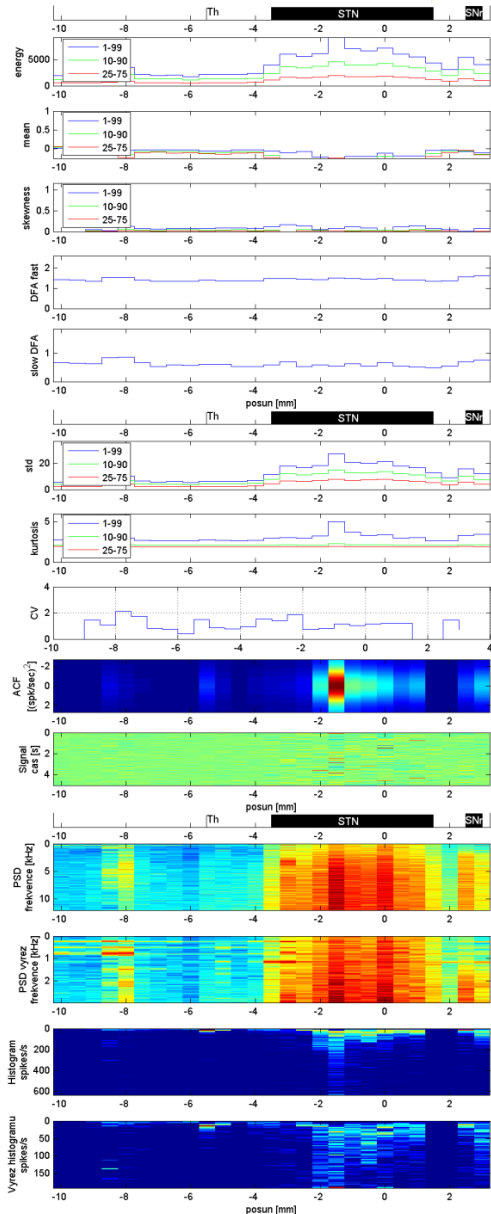
Neuron single action potential







3) Visualization of navigation – raw parameters



Micro electrode recording: DATE: 14/2/06

Kub_J_STNdex

Brain Target: STN dex

	Center EL	Anterior EL	Posterior EL	Medial EL	Lateral EL	DBS Lead Position
T-10	R				R	Medial
T-9				R		
T-8						
T-7					R	
T-6	R				R	
T-5	R STN		R			3
T-4						
T-3	R STN					2
T-2						
T-1			STN	STN		1
Target						
T+1		STN				0
T+2						
T+3			STN	STN?		
T+4						
T+5						
T+6						
T+7						

– Annotation
– Surgery protocol

all plots

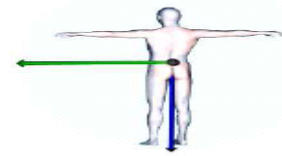
4.0 mm post AC-PC
12 mm lat od AC-PC
3 mm post AC-PC (ACCP)

OK

dist. lower 40° + 1.5°
R lat

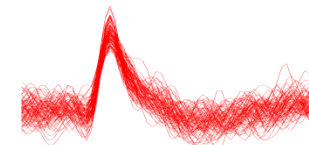
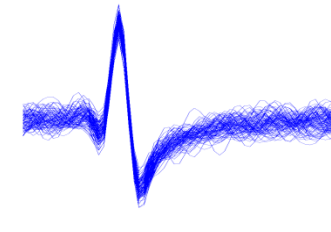
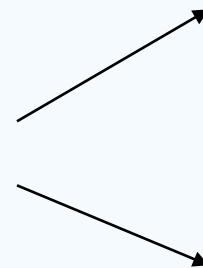
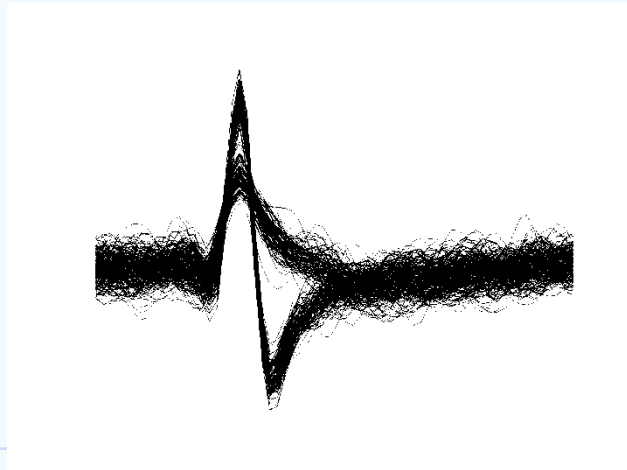
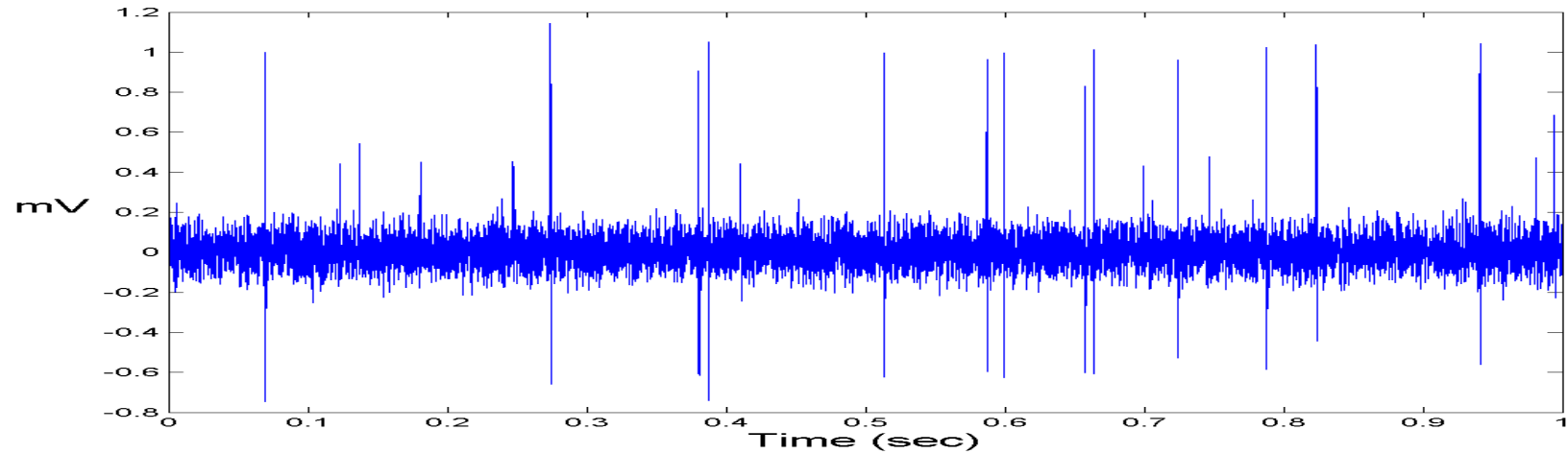
0.2 mm lower 34° - 6°
post lat



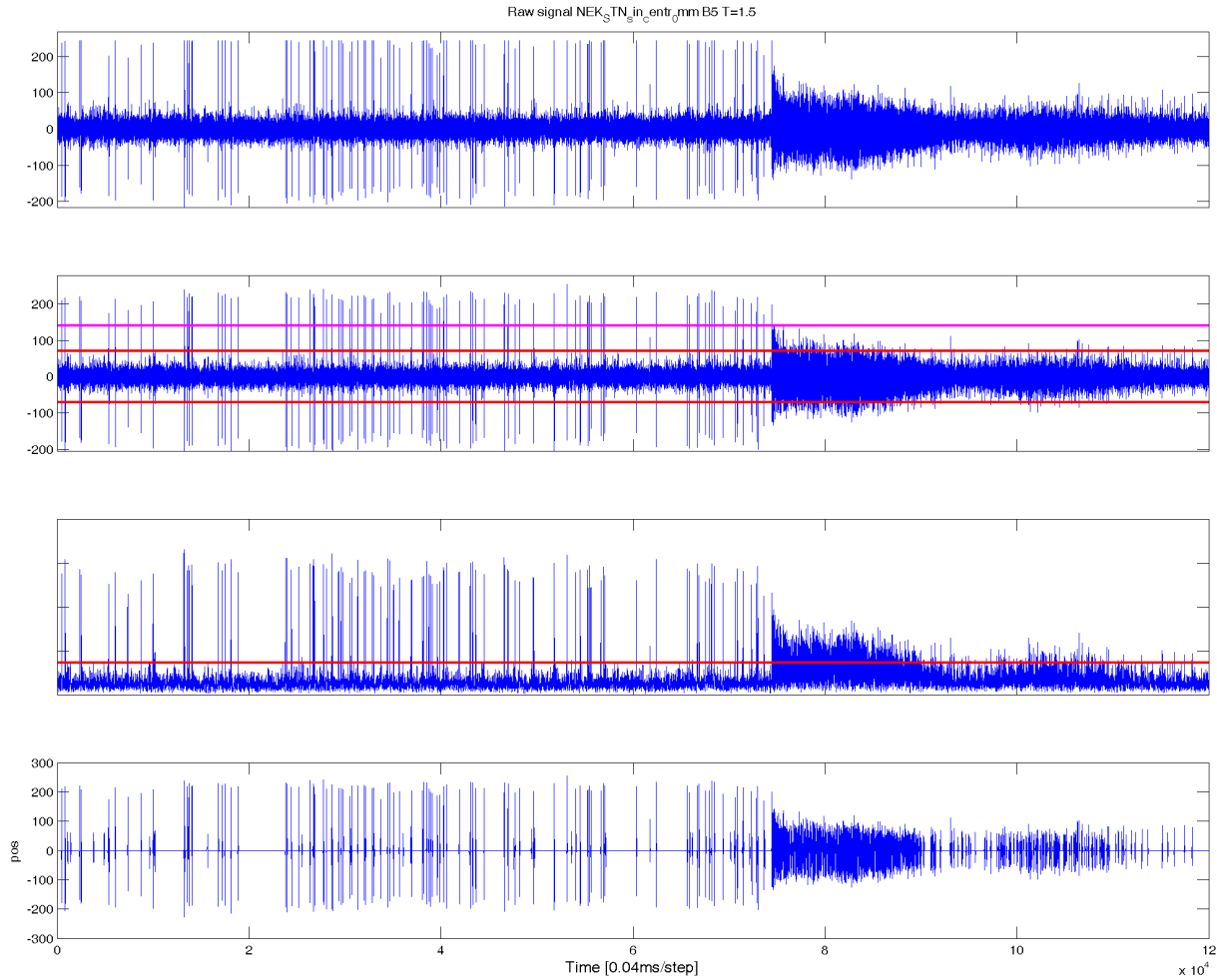
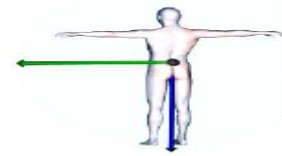


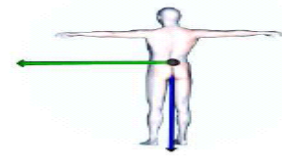
Main Idea

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

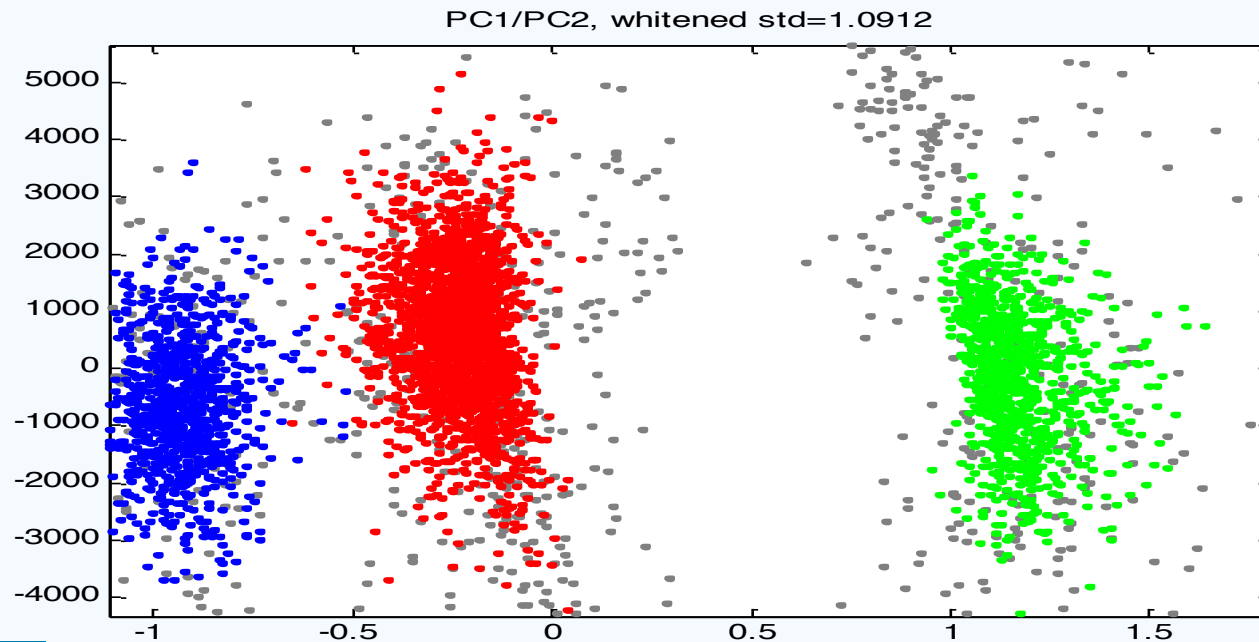
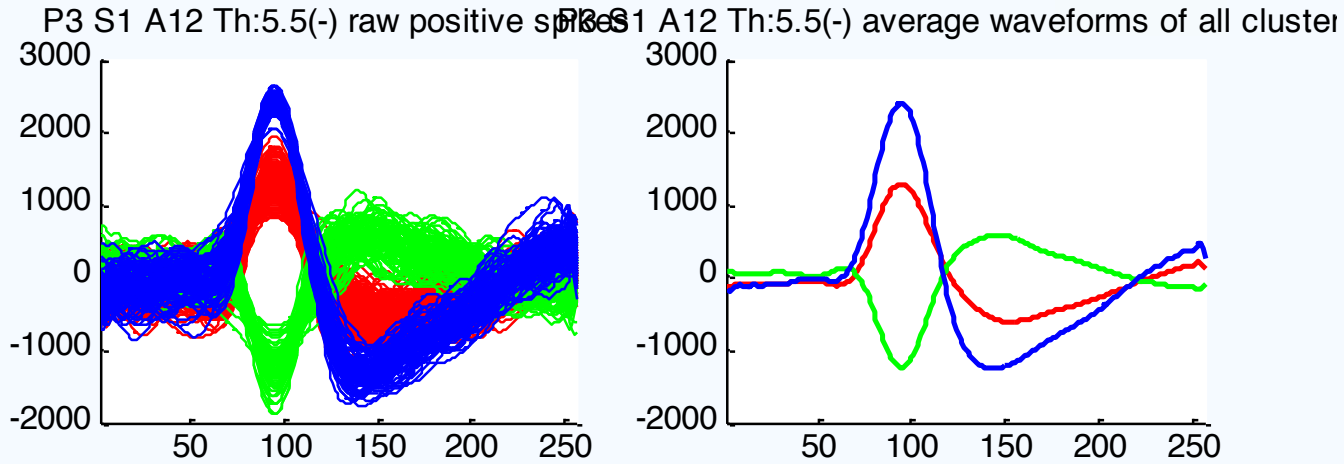


Spike Detection

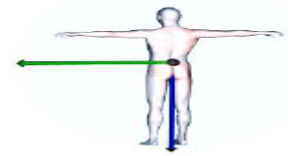




Spike Sorting: one channel, 3 cluster, PCA projection



Dependence UPDRS or depression?



Stimulation

Neurons STN

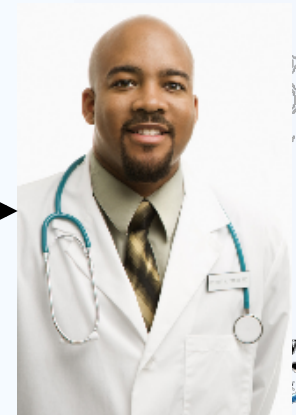


UPDRS score

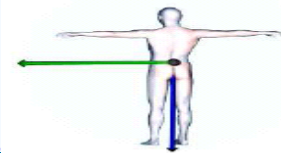
Statistical analysis



Motoric examination



IAPS experiment



- affective visual stimulation
- a series of 24 IAPS pictures

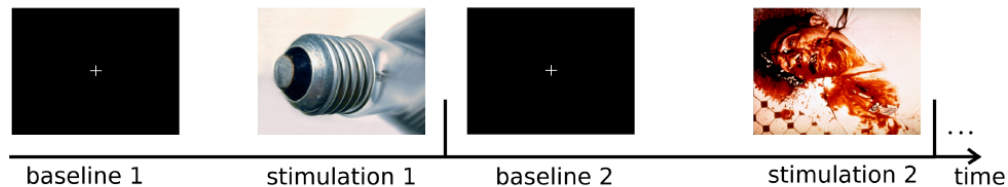


MicroEEG Data Recording

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

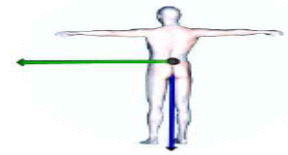


- 10 patients
- 43 recording positions
- 141 recordings (74 from STN)
- 173 minutes (89 from STN)
- 176 neurons (101 in STN)



- presentation for 2s + 2s
- recording during presentation
- pseudorandom ISIs
- pseudorandom picture emotional content
- uniqueness





Bipolar & Schizophrenia Analysis

People:

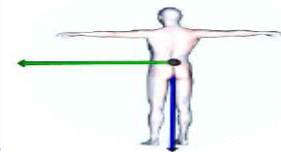
Daniel Novak, Ing. Jan Hrdlicka (PhD), Katerina Sedlackova (DP), Jan Poupe (DP), Radek Jedlicka (BP), **PPC:** MUDr. Filip Spanel PhD, **EPSA:** (Dr. David Cuesta Frau)

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



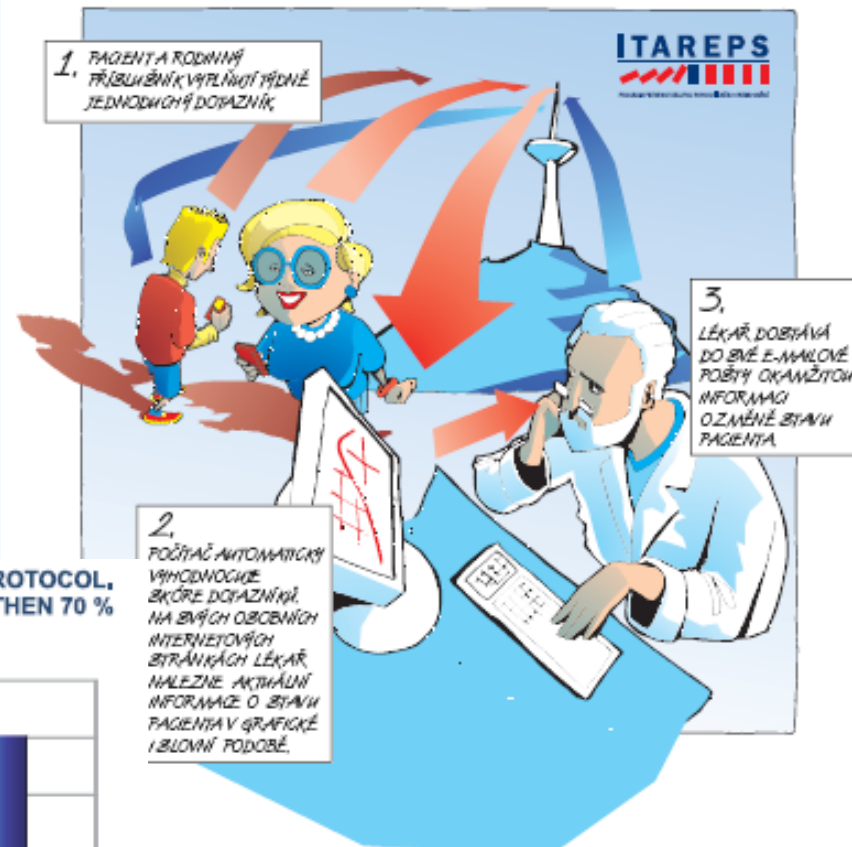
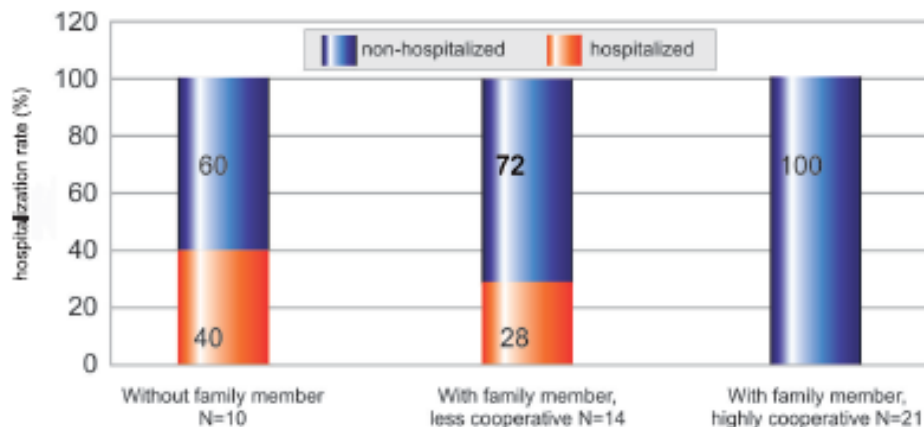
Goal: Schizophrenia Relapse Prediction, Prediction of Mania and Depressive states



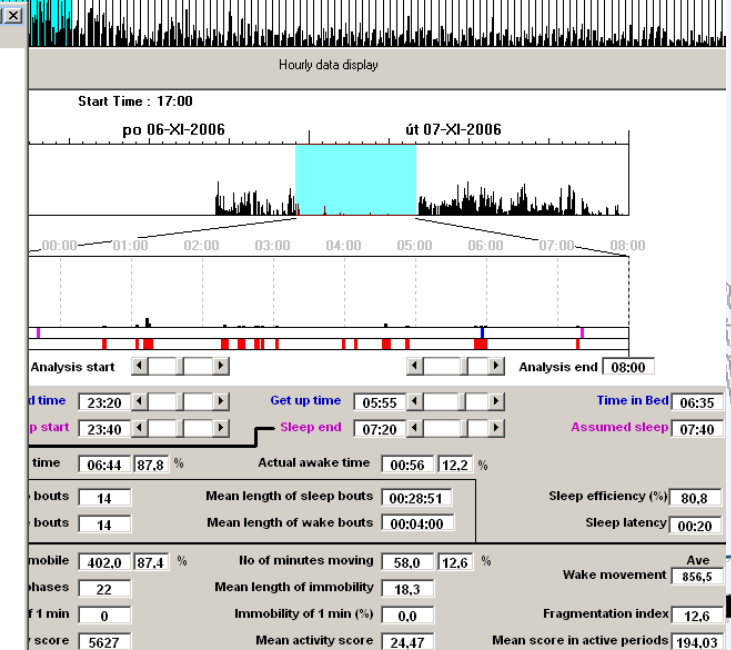
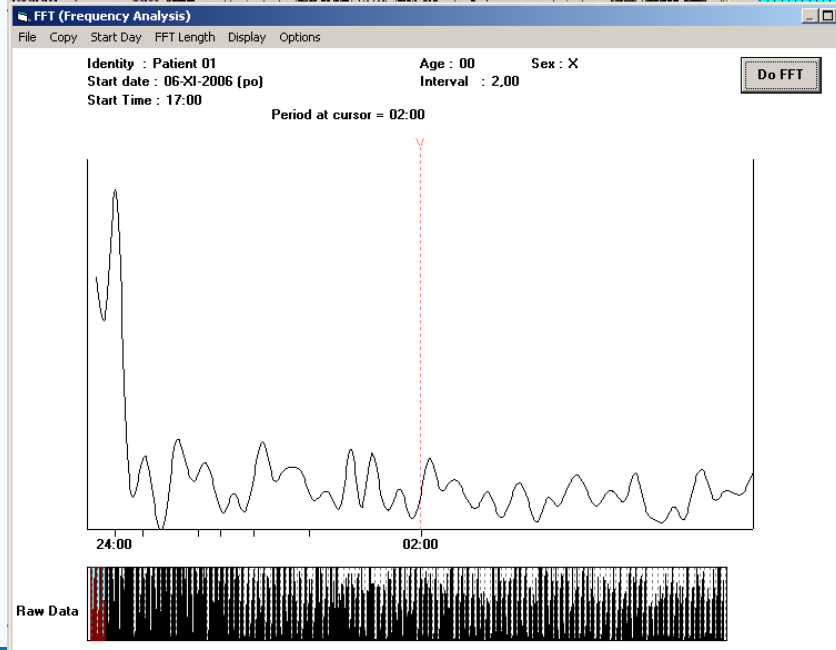
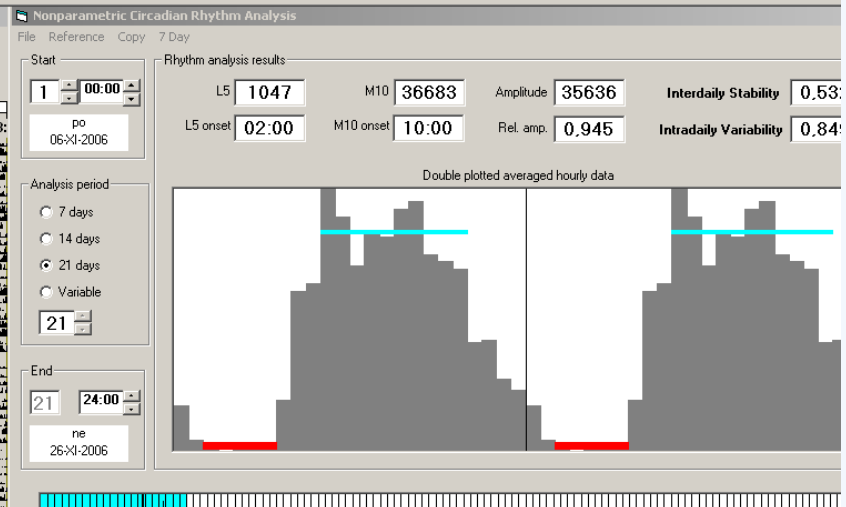
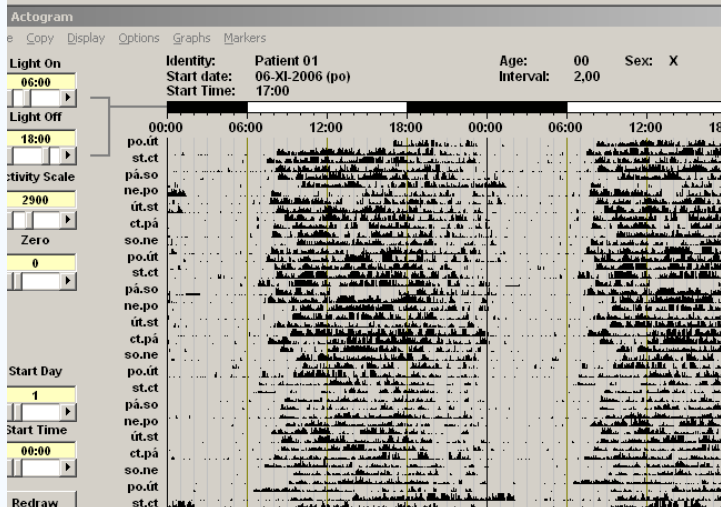
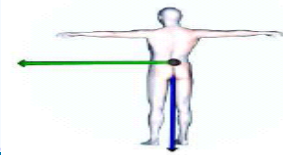


ITAREPS
PROGRAM PREVENCE
RELAPSU PSYCHOTICKÉHO
ONEMOCNĚNÍ

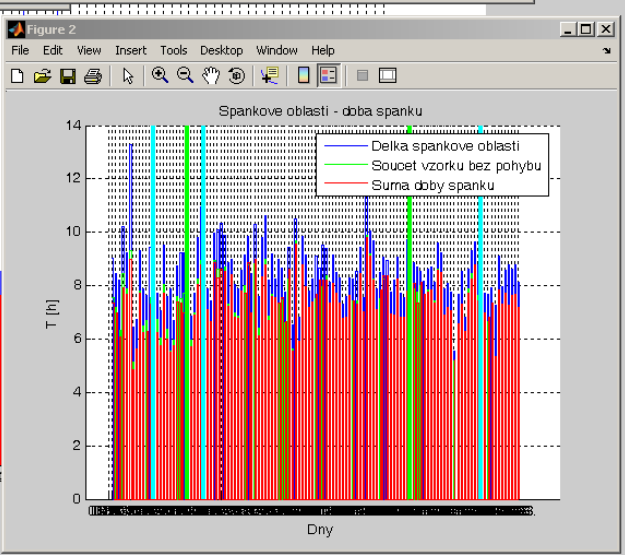
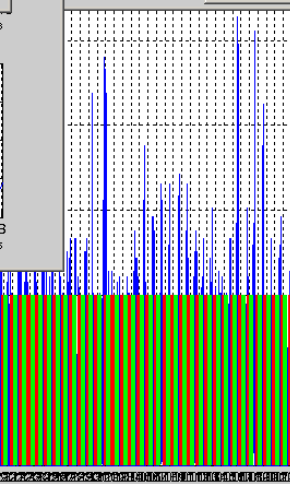
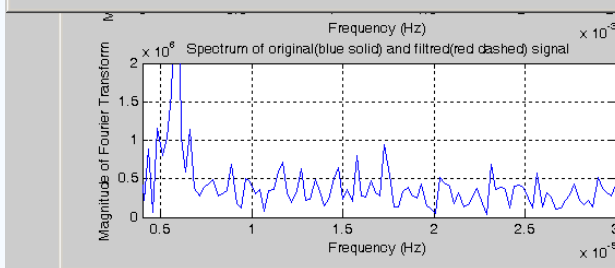
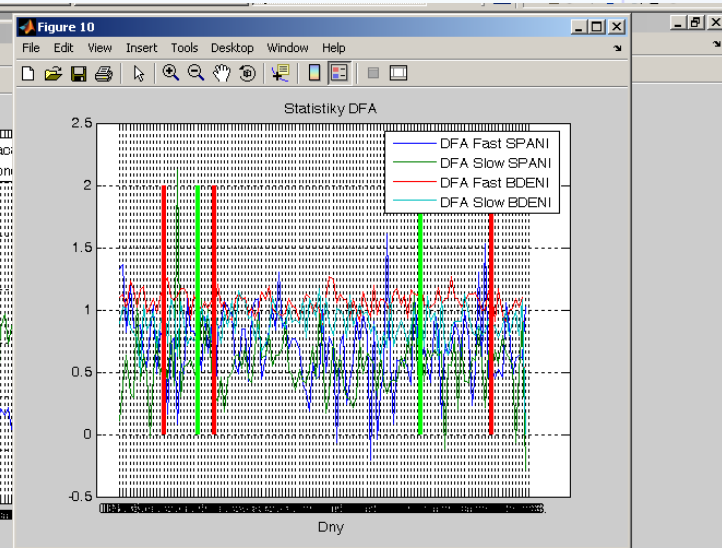
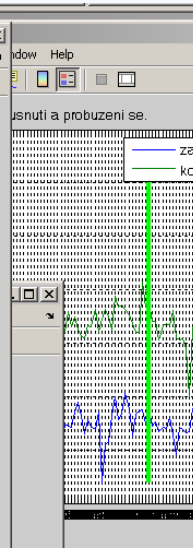
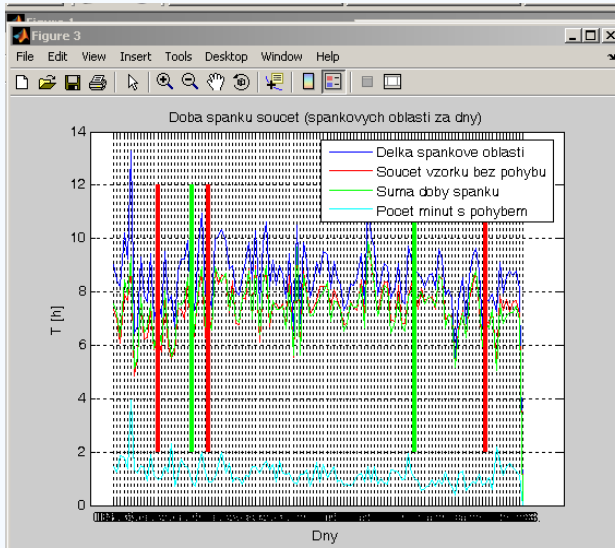
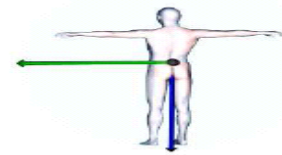
Fig. 1: HOSPITALIZATION RATE AND ADHERENCE TO THE ITAREPS PROTOCOL, CUT OFF POINT OF COOPERATIVENESS DEFINED AS MORE OR LESS THEN 70 % OF REQUIRED EWSQ QUESTIONNAIRES RETURNED



Sleep Analysis by Cambridge Neurotechnologies



Sleep analysis



Questionnaires

