# Technical University Sofia, Bulgaria

## Project Work 1

**SUBJECT: THEMATIC AREAS FOR PROJECTS**

Student projects are separated in 4 different thematic areas. Each project is specified depending on students' knowledge, skills and specialization during their practical education course in Laboratory "CAD/CAM/CAE in Industry".

The following thematic areas are available for international students projects:

**T.1.DESIGN AND DEVELOPMENT OF MECHANICAL PRODUCTS**

**Specification:** This type of projects includes application of contemporary CAD/CAM/CAE tools in mechanical design of new products. Innovative products development allows student to enter in a specific area of engineering knowledge.

**The projects accents are on the next sub-directions:**

- Innovative Products Design

- Design of complex shapes and forms

- Cost Effective Design

- Design-for-Manufacturability

- Desing-for-Realiabilty

**T.2.PDM SYSTEMS**

Specification: Product Data Management systems are a conventional tool in modern engineering bureaus. This thematic area provides research topics in directions of data organisation and processing.

T.3.ENGINEERING ANALYSIS. STRUCTURAL SIMULATIONS (ANSYS FAMILY OF PRODUCTS)

Specification: Projects in structural engineering analyses area are oriented on simulations of developed design at early stages of product lyfe cycle, using virtual prototype. Structural simulations include static, dynamic, fatigue and thermal analyses using contemporary software system – ANSYS and MSC families of products.

 Next specific sub-directions are covered:

- Geometry preprocessing

- Steady state analysis. Fatigue. Contact problems

- Dynamics analysis

- Thermal analysis

- Specific analyses (buckling, earthquake, random vibration, etc.)

## T.4.RAPID PROTOTYPING TECHNOLOGIES

Specification: Both additive and removal technology equipment for rapid prototyping are available in Laboratory "CAD/CAM/CAE in Industry". Next specific technologies are available for students practical education and review:

- Reverse engineering (scanning and geometry data processing)

- Additive technologies in plastics and metal

- Removal technology in micro and macro scale

# Topics for practice of Indian students in the Department of Electronics

### 1. Temperature sensor with Internet connectivity

In this project students will learn about embedded networking using deeply-embedded microcontrollers. This project includes the MSP430FR5739 and externally connected analog (NTC thermistor) or digital (TMP102) sensor for temperature measurements. The board is equipped with a CC3000 Wi-Fi module. It can be connected to a router and the readings of the sensor can be made available over the Internet. Some basic HTML programming will be needed. Students will learn how to make the link HTML - C code.

### 2. Accelerometer sensor with Internet connectivity

In this project students will learn about embedded networking using deeply-embedded microcontrollers. This project includes the MSP430FR5739 and externally connected or digital (ADXL335) sensor for temperature measurements. The board is equipped with a CC3000 Wi-Fi module. It can be connected to a router and the readings of the sensor can be made available over the Internet. Some basic HTML programming will be needed. Students will learn how to make the link HTML - C code.

### 3. Microserver with SD card and Ethernet interface

In this project students will learn about embedded wired networking using deeply-embedded microcontrollers. This project includes the LM3S9B92 board and externally connected SD card. The board is equipped with a 10/100 Mbit Ethernet port. The students will learn about interfacing an SD card through SPI interface as well as some basic programming about embedded file system FAT32.

### 4. Control of grid-supplied consumers over the Internet

In this project students will learn about embedded wired networking using deeply-embedded microcontrollers. This project includes the LM3S9B92 board and externally connected electro-mechanical relays. Students will have to solder the relays and the electronic switches (transistors) themselves on an experimental board. Knowledge about embedded TCP/IP stack will be acquired.

### 5. Automatic fish-tank feeder with Internet connectivity

In this project students will learn about embedded wired networking using deeply-embedded microcontrollers. This project includes the LM3S9B92 board and externally connected electro-magnets. The student will have to implement the Internet connection using TCP/IP libraries and a real-time clock measurement of time. Some basic HTML programming will be needed. Students will learn how to make the link HTML - C code.

### 6. Wi-Fi network connected embedded systems

In this project students will learn about embedded networking using deeply-embedded microcontrollers. This project includes some MSP430FR5739 demo boards. The real number of

boards depend on the signed up students but minimum of 2 and maximum of 6 boards are avaible. The students will be able to transfer any kind of digital data between boards. The server and client side of the communication will be implemented by the students.

7. **Arduino based projects**

In this field students will develop skills in program control of external devices. The projects include temperature measurement and control, LCD and LED displays control and etc. 8 working places are provided consisting computer, development board and peripheral components. The projects will emphasize on the practical work and will help students in programming using C language and in measurement and control.

8. **Raspberry Pi based projects**

The projects will emphasize on distance control using Ethernet networking. The topics include compiling and installing software packets, integrated development environments for software development, Phyton programming language, development of graphical user interfaces, using Arduino as an intelligent peripherals for Raspberry Pi and etc.

9. **Analog and mixed-signal circuits**

On this practice (within the framework of four weeks) the students are going to analyze and design some of the most popular analog and mixed-signal circuits. During the first week the students will study some basic electronic circuits, such as basic single-stage amplifier circuits, differential amplifiers, cascode amplifiers, output stages, active filters, oscillators, analog-to-digital and digital-to-analog converters, with laboratory development boards. During the next three weeks the students will be able to design two small-signal electronic circuits, employing discrete transistors (bipolar and MOS) and Op Amps and will prototype them on experimental PCBs. At the end of the course the students should prepare and submit a folder with a report on the job done.

**PREREQUISITES: Electrical engineering – basic definitions and concepts; Semiconductor devices; Signals and Systems; Control theory and Software (Cadence OrCAD).**

## Project 1 - Mobile robot controlled by thoughts and emotions
### Abstract
This project is about creating a software for controlling a robot using thoughts and emotions in order to help people with disabilities to interact with the environment.
The robot can be a robotic hand, robotic vehicle or etc.
### Max students: 4 Technologies
C++, C#, Java
Emotiv SDK, APIs by Technical University - Sofia

## Project 2 - House remote control
### Abstract
The project is about to create a mobile application for remote controlling a smart home. In the home are mounted different sets of sensors for collecting information about the state of the house.
The mobile application should connect to the house and monitor these sensors. The mobile application can control the lighting and different electronic devices at home.
It is possible to connect the application to server/cloud service to provide one home to be controlled by more than one devices at the same time.
### Max students: 5
### Technologies
C++, C#, Java
Raspberry Pi, Android, Windows Phone

## Project 3 - Intelligent home entertainment system
### Abstract
As a part of the home interacting experience, the home entertainment system is one of the most used things at home. This project is about creating a software for responsive control of the home environment based on the current activity of the user.
For example - if the user is watching a movie at home the indoor light should dim. If the the user is listening to smooth music the light can change its intensity in smooth way.
It they are doing a home party with louder music, the lighting can change rapidly with the rhythm of the beats.
### Max student: 5
### Technologies
C, C++, C#, Java Project List from Faculty of Computer Systems and Control Arduino, Rasberry Pi, Android, Windows Phone
Algorithms for signal processing

## Project 4 - Interactive playground for children
### Abstract
This project is about creating a playground which changes when children are playing on it. For example: the system is projecting a city map on the ground and the children who are playing with toy cars can go on different places on the map and collect points.
### Max students: 4
### Technologies
C++, C#
Kinect SDK, OpenCV

## Project 5 - Safety car assistant

### Abstract

Most of the car crashes are caused by lack of concentration behind the wheel and not keeping a safe distance to the car in front, or changing lanes without paying attention for vehicles next to the car. This project is about detecting the boundaries of the lane and to inform the driver if he/she is going to change the lane without indicating for his/her intention.
The system should also try to determine the distance to the vehicle in front and signalize if this distance in not safe enough.

### Max students: 5

### Technologies

C++, C#, Java
Raspberry, OpenCV, wiringPi

## Project 6 - Drone Controller

### Abstract

This project is about controlling an UAV with the sensors of a mobile phone. The user can interact with the drone using the phone as a game pad.
The mobile application should show the streaming from the FPV camera of the drone.

### Max students: 4

### Technologies

C++, C#, Java
ArduPilot, Android, Windows Phone, Raspberry Pi

## Project 7 - Drone Vision

### Abstract

This project is about implementing a computer vision in an UAV to follow an object. The drone is streaming a real-time video to the user. The user and select from the screen the object and the drone should start follow it.
The application on the PC should show the telemetry of the copter and define boundaries where the drone is allowed for fly over.

### Max students: 5

### Technologies

C++, C#
ArduPilot, WPF, OpenCV, EmguCV

## Project 8 - 3D Mapper

### Abstract

The project is about creating a 3D map of a room using a robotic vehicle and Kinect Sensor. The robot should walk around the room and scan it. Then it should process the data and create a 3D map of the room.

### Max students: 5

### Technologies

C#, C++

OpenCV, KinectSDK Project List from Faculty of Computer Systems and Control

# Project 9 - Interactive Mobile Game

## Abstract

This project is to create an game for mobile phone. The game provides the user challenges based on his current location. The user can walk around and complete different missions and collect different virtual items when he reaches some coordinates.

The game can also interact with other users, so they can collaborate or "fight" for resources and items. The game is connected to cloud system which collects data for the user progress, level and collected items.

## Max students: 4

## Technologies

Java, C#, PHP, C++, SQL
Android, Windows Phone, ownCloud API, TCP Sockets, JSON

# Project 10 - Mood watcher

## Abstract

The projects collects data from Emotiv EPOC sensor and send it to an ownCloud application which creates a statistic how the user is feeling.

It can also collect data from the running applications on the computer or the music which is playing in order to determine a correlation between the brain activity and the mood.

## Max students: 5

## Technologies

C#, PHP, Java, SQL
WPF, ownCloud API, Java EE, JSON

# Project 11 - Feauture search

## Abstract

The project is about filtering user data which is uploaded the cloud. The project finds all of the pictures uploaded on the cloud and apply computer vision algorithms to detect extract different features - color, faces, buildings and etc.

## Max students: 4

## Technologies

C++, Java, PHP
ownCloud API, OpenCV, Java EE

# Project 12 - AI Hexapod

## Abstract

This project is to create an intelligent algorithm for walking pattern of a hexapod (robot with six legs). The robot is equipped with accelerometer and gyroscope.

The Hexapod should teach itself how to walk using the sensors as a feedback. It is possible to use a outside camera for determine the position of the robot on the playground.

## Max students: 5

## Technologies

C, C++, Java

Arduino, Raspberry Pi, OpenCV, Servo PWM Interface, I2C Interface

## Project 13 - Home assistant

### Abstract

The project is to create a system for speech recognition for a robot or computer assistant program which can check e-mail, weather, play music, execute orders for movement, sense temperature and interact with different devices.

### Max students: 4

### Technologies

Java, Python, C# Google Play, Jasper, Cortana

# Important

1. All student should use git version control system.

2. It is possible if you generate an idea for similar project, based on the technologies

3. It is not compulsory to use all of the listed technologies. These technologies are just for the guideline and can vary depends on the approach of the solution.

# Faculty of Mechanical Engineering

**1. Measurement of mass**

In this project the students are going to acquire the theoretical and practical knowledge and skills on the methodology of measurement of mass. The project offers some theoretical tasks and possibility of experimental verifications with the existing laboratory facilities.

**2. Measurement of force and moment of force**

In this project the students are going to acquire the theoretical and practical knowledge and skills on the methodology of measurement of force and moment of force. The project offers some theoretical tasks and possibility of experimental verifications with the existing laboratory facilities.

**3. Measurement of pressure**

In this project the students are going to acquire the theoretical and practical knowledge and skills on the methodology of measurement of pressure. The project offers some theoretical tasks and possibility of experimental verifications with the existing laboratory facilities.

**4. Measurement of flow (flow rate)**

In this project the students are going to acquire the theoretical and practical knowledge and skills on the methodology of measurement of flow rate. The project offers some theoretical tasks and possibility of experimental verifications with the existing laboratory facilities.

**5. Measurement of temperature**

In this project the students are going to acquire the theoretical and practical knowledge and skills on the methodology of measurement of temperature. The project offers some theoretical tasks and possibility of experimental verifications with the existing laboratory facilities.

**6. Measurement of angular velocity (rotational speed)**

In this project the students are going to acquire the theoretical and practical knowledge and skills on the methodology of measurement of angular velocity. The project offers some theoretical tasks and possibility of experimental verifications with the existing laboratory facilities.

**7. Medical dispensers**

In this project the students are going to acquire the theoretical and practical knowledge and skills about design of different types of medical dispensers. The project offers some theoretical tasks and possibility of experimental verifications with the existing laboratory facilities.

**8. Thermographic inspection of impact damage in composite materials.**

The work concerns the problems for the inspection of low velocity impact damage in glass-fiber reinforced polymers. Although there are many methods for the inspection of composites the need for

more accurate and faster inspection methods requires the development of new technologies for control. The application of Infra-red thermography for the control of composite materials is state of the art technology and is still in development stage.

## 9. Monitoring of curing process in cyanoacrilate adhesives.

A major aspect regarding the attainment of the desired properties of adhesive joints is the control of the curing of the employed adhesive. This is required in order to distinguish the different stages of the structural formation of the adhesive. In this study, ultrasonics will be employed for the monitoring of the polymerization of a typical cyanoacrilate adhesive. A wave generator will be connected to a high frequency acoustic transducer in order to transmit elastic waves through the thickness of hardening adhesive layer. Different parameters like the wave velocity and attenuation will be monitored in order to examine the rate of hardening and obtained material properties.

## 10. Monitoring of curing process in thermosetting adhesives

A major aspect regarding the attainment of the desired properties of adhesive joints is the control of the curing of the employed adhesive. This is required in order to distinguish the different stages of the structural formation of the adhesive. In this study, ultrasonics will be employed for the monitoring of the polymerization of a typical epoxy adhesive. A wave generator will be connected to a high frequency acoustic transducer in order to transmit elastic waves through the thickness of hardening adhesive layer. Different parameters like the wave velocity and attenuation will be monitored in order to examine the rate of hardening and obtained material properties.

# FACULTY OF POWER ENGINEERING AND POWER MACHINES

**1) ANALYSIS OF SPENT FUEL DECAY HEAT AND ACTIVITY AS A FUNCTION OF THE FUEL TYPE AND REACTOR'S OPERATIONAL PARAMETERS.**

The decay heat and activity pose high requirements for spent nuclear fuel transportation, interim and permanent storage. The results from the will help develop strategies and technologies for maximally safe and efficient SNF management.

**2) ANALYSIS OF MINOR ACTINIDES' PRODUCTION RATES IN DIFFERENT REACTOR TYPES AND STUDY OF THE OPTIONS FOR THEIR TRANSMUTATION (THAT MEANS THAT WE SEEK TO TRANSFORM THEM INTO OTHER ELEMENTS THAT ARE MUCH EASIER TO MANAGE AND STORE).**

Radioactivity and decay heat are main characteristics of spent nuclear fuels and represent a serious challenge for its management. Minor actinides have major contribution to these negative effects in spite of their relatively low concentration in the spent fuel. The possibility for partitioning and transmutation of these elements would make spent fuel much more manageable and nuclear energy even more sustainable. The analysis of minor actinides' production rates and the options for their transmutation is a necessity in implementing future nuclear fuels and increasing the sustainability of nuclear power.

**3) STUDY ON THE DIFFERENT OPTIONS FOR PLUTONIUM PRODUCTION IN POWER REACTORS AND ITS ROLE AS AN ENERGY RESOURCE. ANALYSIS OF THE SAVINGS OF DIFFERENT ENERGY RESOURCES THAT RESULT FROM PLUTONIUM UTILISATION.**

World's energy demand is constantly increasing. The prices of energy and energy resources could be very volatile and the energy supply is prone to different risks. Plutonium is produced as a by-product from nuclear power generation. Its recycling as a new energy resource is one of the options for its management and could allow us to produce more energy with fewer natural resources.

**4) CODE DEVELOPMENT FOR ANALYSIS OF XENON AND SAMARIUM POISONING EFFECTS IN NUCLEAR FUELS**

The fission products that accumulate in a reactor core during nuclear power plant operating act as long-term heat sources through their radioactive decays and parasitic neutron absorbers (poisons) that, over time, decrease the thermal utilization factor and introduce negative reactivity into a core. Most important effects in nuclear reactor operation is poisoning decay of Xenon and Samarium.

**5) ANALYSIS OF THE PROLIFERATION RESISTANCE OF DIFFERENT NUCLEAR FUEL CYCLE OPTIONS**

Nuclear energy provides us with cheap, reliable, and environmentally friendly power source. Nevertheless, there are materials that could be used in nuclear arms development which are produced during nuclear reactors' operation. Proliferation resistance is this feature of nuclear power that helps making these materials less and less usable as weapons material. These types of analyses are very important in advancing civilian nuclear power and its acceptability by the public worldwide.

### 6) THERMAL-HYDRAULIC ASPECTS OF DETERMINISTIC SAFETY ANALYSIS OF NPP

The objective is to provide theoretical basis for deterministic safety analysis of nuclear power plant and practical use of thermal-hydraulic system codes such as RELAP5 and TRACE for analysis of design basis accidents. This topic may include Reactor safety fundamentals and Deterministic safety analysis, Design basis accidents and their classification; Thermal-hydraulic simulation tools for analysis of design basis accident; Physical and mathematical models of thermal-hydraulic system codes; Validation and verification of the computational models and the system codes; Hands-on training developing and running models for VVER and PWR reactors.

### 7) SIMPLIFIED MATHEMATICAL MODELING OF ENERGY FACILITY IN MATLAB ENVIRONMENT

Simplified mathematical modeling of energy facility in MATLAB environment development is carried out in the following few steps: Primary and secondary elements and systems qualification; Processes and phenomena qualification that occur in these elements, systems and equipment of energy facility; Linking the different models into single one model of whole facility. Mathematical models development will be realized by presenting the physical laws in mathematical terms. This describes physical processes and phenomena that occur in elements, systems and equipment under consideration in terms of different types of equations.

### 8) WATER CHEMISTRY AND WATER TREATMENT FOR NUCLEAR POWER PLANTS

The light water reactors (LWR) as a type of thermal-neutron reactors use normal water as both coolant and neutron moderator, due to its appropriate thermal properties, high density, radiation stability, comparatively low neutron cross-section, etc. Water is in contract with a variety of constructional materials, such as stainless steel, zirconium and nickel-chromium alloys, carbon steel, copper and titanium alloys, etc. and depending on the type of LWR - boiling water reactor (BWR) or pressurized water reactor (PWR), it behaves as reduction or oxidation medium. The current generation nuclear power plants (NPPs) have to meet the number of requirements longer time of life, safety and effectiveness that can be achieved by the improvement of the constructional materials, corrosion control and optimal water chemistry. In the frame of this topic the corrosion behaviour of different metal-water systems, water quality indicators and parameters of water chemical treatment will be studied by using classical and modern analytical approaches. The dynamic in water chemistry in order to overcome the corrosion problems in steam generator cycle will be studied.

### 9) SYNTHESIS AND SURFACE STUDIES OF ZEOLITIC ION-EXCHANGERS FROM RESIDUAL ALUMINOSILICATES AND THEIR APPLICATION IN NUCLEAR SAFETY SYSTEMS

Zeolites are highly valuable natural and synthetic aluminosiclicate materials that are broadly applied in environmental protection systems due to their unique porous structure favourable for surface phenomena that determine their applications as adsorbents, catalytic carriers, molecular sieves, etc. The structural features, as well as the chemical inertness and resistance of these materials to radiation make them a powerful tool for the decontamination of waters containing radionuclides based on their ion-exchange properties. The use of zeolites with well-pronounced ion-exchange capability such as clinoptilolite,

chabazite, linde, etc., in nuclear waste decontamination is a well-established practice. In the scope of this topic, synthetic zeolites will be prepared by alkaline conversion of residual aluminosilicates, e.g. coal ash, using different approaches – hydrothermal treatment, self-crystallization, two-stage conversion, etc. The synthetic zeolites will be thoroughly studied with respect to their morphology, crystallinity, specific surface

and pore size distribution using modern analytical techniques. Their ion-exchange capacities and selectivity will be studied toward variety of ions. This approach will contribute to resolve severe environmental problems in worldwide scales, such as natural resources economy for count of utilization of waste resources for obtaining of ion-exchangers that could be applicable for radioactive water decontamination.

## 10) SYNTHESIS OF ZEOLITES FROM WASTES OBTAINED BY ELECTRICAL PRODUCTION

During this course every young researcher individually perform laboratory experiments. The task is to obtain synthetic zeolites with high porosity for application in waste gas adsorption systems as in thermal and nuclear power plants. The treated raw material is fly ash from coal combustion systems. The aim of the task is to choose optimal synthesis conditions and to evaluate their influence on the properties of final solid materials.

## 11) ANALYTICAL DETERMINATION OF SPECIFIC SURFACE PROPERTIES OF SOLID MATERIALS

With the help of specialized equipment (Micromeritics, Tristar II 3020) for volumetric adsorption experiments have to be analysed specific surface properties of different solid materials which can be used as adsorbents, catalyst, and so on. During the experimental work the adsorption isotherms of nitrogen at 77 K and carbon dioxide at 273.15 K are built. Mathematical models are applied to the obtained graphic results for calculation of surface area, pore sizes, pore size distribution etc.

## 12) SIMULATING PULVERIZED COAL COMBUSTION, COAL/BIOMASS CO-COMBUSTION AND SLAGGING IN A FURNACE USING THE LAGRANGIAN APPROACH IN CODE_SATURNE

Study an example of simulation of biomass slagging in a co-combustion (coal / biomass) case where most of the pulverized fuel remains coal (90% of injected mass). In detail, this will demonstrate how to: Create a new "Pulverized Coal Combustion" case and launch Code_Saturne "Graphical User Interface"; Prepare a Eulerian frozen field to serve as an input for the particle tracking calculation; Set up (and explanation) of the appropriate computational parameters for the Lagrangian computation.

## 13) Practical course: Design of yarns and woven fabrics

The course on "Design of yarns and woven fabrics "deals with the fundamentals of the design of yarns and fabrics: technological background, machines, theoretical calculations of yarns and fabrics. Special attention is paid to weave patterns: construction of weave diagrams, technological relationship with machine settings, color design, CAD systems.

## 14) MODELLING OF PROCESSES IN POWER PLANTS

Study to use an intuitive process modelling software that helps engineers create steady-state and dynamic models for plant design, performance monitoring, troubleshooting, business planning, and asset management. Major use cases in process modelling using this software include: Process flowsheet development; Utilizing case scenarios tool to optimize designs against business criteria; Equipment rating across a broad range of operating conditions; Evaluating the effect of feed changes, upsets and alternate operations on process safety, reliability and profitability; Accurately size and select the appropriate material for blowdown systems; Monitoring equipment performance against operating objectives.

# FACULTY OF TELECOMMUNICATIONS - PROJECT TOPICS

**Virtual Reality applications for disabled users**

In this project the students will develop applications for the virtual reality head set Oculus Rift DK2 for enabling people to interact with others through avatars. Avatars are graphical representations of human beings and can be customized to fit individual requirements. These avatars navigate their environment, participating in activities and socializing with other people. At the end the students will have an application integrating body tracking module with Kinect sensor and avatar module in the virtual world following the movement of the user's body.

**PREREQUISITES:** Computer graphics, Unity 3D, C++/C#, image and video processing. (3 students)

## MUSCLE FATIGUE ASSESSMENT WITH EEG AND EMG SIGNALS

Neuromuscular electrical stimulation (NMES) is a widely used technique for rehabilitation in physical therapy, however it causes muscle fatigue rapidly. In clinical practice, it becomes necessary to monitor muscle fatigue during NMES protocols to adjust the parameters of electrical current stimulation and, thus, increase stimulation time. The students will use the EEG Emotiv EPOC+ a wireless EEG system for research enabling research & usability testing in neurotherapy and Myo armband for measuring EMG signals to develop a testing technique for measuring muscle fatigue.

**PREREQUISITES:** Matlab, Unity 3D, C++/C#, signal processing. (3 students)

## SOFTWARE DEFINED RADIO

In this project the students are going to learn software defined radio components, architecture and block diagrams. They are going to design and develop basic algorithms for signals and information processing. In the end the digital radio transceiver will be design and test.

**PREREQUISITES:** Radiocommunications, Signals and Systems, Signal Processing, Matlab Programming. (3 students)

## MEASUREMENT AND CONTROL OF RADIO COMMUNICATION SOURCES OF NON-IONIZING RADIATION

In this project the students are going to acquire the theoretical and practical knowledge and skills on the methodology of measurement and assessment of non-ionizing radiation sources as TV, FM Radio, GSM, UMTS systems.

**PREREQUISITES:** Radiocommunications, Antennas, Propagation of Electromagnetic Waves, Mobile Communications. (3 students)

## NONCONTACT INFRARED TEMPERATURE MEASUREMENT

In this project the students are going to learn infrared thermometers and cameras, architecture and block diagrams. They are going to design and develop basic algorithms for measuring and temperature data processing. In the end the experiment with real application will be design and test.

**PREREQUISITES:** Physics, Optical Systems, Signal Processing. (2 students)

## BIOFEEDBACK BASED ON OPTICAL AND ELECTRICAL MEASUREMENTS

In this project the students are going to acquire the theoretical and practical knowledge and skills on the methodology of measurement and assessment of temperature and electrical potentials of human body during the medical therapy.

**PREREQUISITES:** Physics, Optical Systems, Signal Processing. (2 students)

## WIRELESS AND MOBILE AUDIO STREAMING TECHNOLOGIES

In this project the students will learn the principles and structures of wireless and mobile audio streaming technologies, the architecture and block diagrams of wireless and mobile audio systems. They will design the basic algorithms for audio streaming via wireless and mobile audio professional or home networks developing real working applications for audio information streaming and also applications of remote control of wireless and mobile audio system using smart phones or tablets.

**PREREQUISITES:** Audio Systems, Wireless and Mobile Networks, Audio Streaming, Matlab, Simulink, Android Studio, Eclipse IDE, Web Design (2 students)

## MICROPHONES, MICROPHONE ARRAYS BASED ON MEMS TECHNOLOGY AND APPLICATIONS IN AUDIO VISUAL MOBILE ROBOTS MOTION CONTROL

In this project the students will learn the MEMS microphones technology. Using the fundamental theory of microphone arrays they will develop practical applications of different structures of microphone arrays, testing them and analysing their ability to determine the direction of sound of arrival from speakers or other audio sources and using the results in real time audio visual mobile roots motion control.

**PREREQUISITES:** Audio Systems, Microphones, Microphone Arrays, MEMS Microphone Technology, Microcontrollers Hardware and Software, Microsoft Mobile Robots Studio (2 students)

**ROOM ACOUSTIC ANALYSIS. SIMULATIONS AN REAL IMPLEMENTATIONS**

In this project the students will acquire basic knowledge and skills about principles of acoustic, specific and principles of room acoustic for audio studios, concert halls, offices, home rooms, etc. These knowledge's will be applied from the students in simulations and practical implementations of real room acoustic analysis, taken the results and conclusions for choosing and using appropriates building materials and building constructions to greatly improve the acoustic characteristics of the room under test.

**PREREQUISITES:** Audio Systems, Acoustic, Room Acoustic, Audio Signal Processing, Neural Networks, Matlab, Simulink, Microsoft Visual Studio, Java, Sound Insulation Materials and Constructions (2 students)

**AUDIO SYSTEMS FOR CREATION, EDITING AND MASTERING OF SONGS AND MUSICAL PRODUCTIONS**

In this project the students will learn the principles, the architectures and basic functions of audio systems for creation, editing, processing and mastering of songs or other musical production. Then students will work with the professional audio editing system PreSonus Studio to develop real practical applications producing the new songs, applying all necessary steps for creation of audio and instrumental tracks, adding the special audio effects, editing and processing all created tracks to form the final release of the created song.

**PREREQUISITES:** Audio Systems, Editing Audio Systems, Audio Signal Processing, Special Audio Effects, Audio Mastering (2 students)

**OBJECTIVE QUALITY ESTIMATION IN AUDIO AND VISUAL COMMUNICATION SYSTEMS AND NETWORKS**

The goal of this project is the students to learn the methods and algorithms of existing means of subjective and objective quality estimation transmitting the audio and visual information via standard cable and wireless multimedia communication systems and networks. The knowledge's will be used as a fundamental base for student to develop and test appropriates algorithms for objective quality estimation of received audio and visual information transmitted via cable or wireless audio visual communication systems and networks.

**PREREQUISITES:** Audio and Visual Communication Systems and Networks, Audio and Visual Streaming, Audio Signals and Image Processing, Neural Networks, Quality of Services (2 students)

**HARDWARE AND SOFTWARE AUDIO AND VISUAL SOLUTIONS IN AREAS OF INTERNET OF THINKS (IOT), DIGITAL SIGNAL PROCESSORS (DSP), GRAPHICAL PROCESSING UNITS (GPU) AND FPGA**

The students will learn the basic principles for development of hardware and software audio and visual solution in area of multimedia communications, audio and visual information processing, coding, recognition, etc. Then students will work with appropriates IoT, DSP, GPU and FPGA modules to

develop the concrete real working IoT, DSP, GPU and FPGA applications in area of audio and visual communications.

**PREREQUISITES:** IoT, DSP, GPU and FPGA hardware and software knowledge and skills, Audio and Visual Communications, Streaming, Processing, Coding and Neural Networks (2 students)

## OBJECT MATCHING BASED ON RECOGNITION FROM LOCAL SCALE-INVARIANT FEATURES

Spotting objects of different kind in digital images and videos is an essential part in many contemporary machine learning applications. Some of the most popular ones include robot localization and mapping, 3D scene modeling, vehicle recognition and tracking, human action analysis, 3D magnetic resonance images decomposition and much more. All the objects that appear of interest to us may vary in shape, color, texture, size, orientation and could be partially occluded by other objects while taking

the image and being illuminated at different conditions. All these factors make the task of object matching really challenging in respect of finding invariant descriptors for the objects to be recognized in various scenes. In the proposed project topic it is considered to employ the local scale-invariant features transform (SIFT) as a starting point towards the development of an application for stable object matching in digital images.

**PREREQUISITES:** Programming in C/C++/Java/Matlab/Other; Digital Signal/Image Processing; Pattern Recognition; Machine Learning. (3 students)

## PERSON IDENTIFICATION BASED ON FINGER VEINS RECOGNITION

Person identification is an important process in numerous security systems whether it is needed in payment terminals, airport control, border checkpoints, law enforcement verification, etc. Recent studies revealed that it is possible to use the human finger veins, mainly from the index, middle and ring fingers, as a unique pattern for identity authentication. Near infrared illumination is used from the obverse side of the finger to project in 2D a halftone image from a CCD sensor of the contained veins. A numerous challenges appear at this process closely related to uneven illumination, low contrast, and complex veins structure which may be similar from person to person in some cases. To overcome these difficulties a number of pattern recognition techniques were developed such as maximal curvature estimation, repeated line tracking and others combined with pre-processing steps assuring higher recognition rates. Still there is a need of increasing the accuracy of such systems for real-life applications. In this project topic it is desired to enhance existing techniques for finger vein recognition either separately or by combining them.

**PREREQUISITES:** Programming in C/C++/Java/Matlab/Other; Digital Signal/Image Processing; Pattern Recognition; Machine Learning. (3 students)

## ROUTING IN IP NETWORKS

In this project the students will learn and perform a simple network node configuration, protocol independent (static) routing configuration, distance vector routing protocols and link state routing protocols. Basic administration skills will be trained. The students will prepare their theoretical research,

and after that network configuration verification process will be implemented. The laboratory is equipped and part of the work will be performed on real network devices (Juniper).

**PREREQUISITES:** Communications Systems and Networks, Data Networks and Internet Communications. (2 students)

## DESIGN OF A COMPUTER NETWORK

In this project the student will learn and practice the design of enterprise computer network. Theoretical research will be performed. After that some examples might be configured and investigated in a real laboratory environment. The laboratory is equipped and part of the work will be performed on real network devices (Juniper).

**PREREQUISITES:** Communications Systems and Networks, Data Networks and Internet Communications. (2 students)

## MPLS NETWORK ARCHITECTURE

In this project the student will learn and practice MPLS technology. Theoretical research will be performed. After that some examples might be configured and investigated in a real laboratory environment. The laboratory is equipped and part of the work will be performed on real network devices (Juniper).

**PREREQUISITES:** Communications Systems and Networks, Data Networks and Internet Communications. (2 students)

## QUALITY OF SERVICE IN IP NETWORKS

In this project the student will learn and practice the basic aspects to achieve the QoS in modern IP networks. Theoretical research will be performed. After that some examples might be configured and investigated in a real laboratory environment. The laboratory is equipped and part of the work will be performed on real network devices (Juniper). Real multimedia traffic sources will be used.

**PREREQUISITES:** Communications Systems and Networks, Data Networks and Internet Communications. (2 students)

## DESIGN OF STRUCTURED CABLING SYSTEM

In this project the student will learn and design a structured cabling system. The design covers the basic topics of the SCS standards, cooper cable categories and application classes, fiber optic cable categories and classes, architecture and topology of a SCS network, characteristics of the main components. Also some additional topics are covered: equipment interconnection topology, grounding and bounding of passive and active components, measurement and certification of wireline and fiber optic networks.

**PREREQUISITES:** Communications Systems and Networks, Data Networks and Internet Communications. (2 students)

**LOCAL AREA NETWORK DESIGN**

**THEORETICAL PART: LOCAL AREA NETWORK TOPOLOGIES AND IEEE STANDARDS.**

Project: Choice of particular site: business building or residence building. Power budget. Traffic dimensioning. Network optimization.

**PREREQUISITES:** Basic knowledge on communication networks. (2 students)

**PASSIVE OPTIC NETWORK DESIGN**

**Theoretical part:** Optical fibers and systems; optical fiber access & network topologies. Project: Choice of particular site: business area or residence area. Power budget. Traffic dimensioning. Network optimization. Access technology determination and equipment specification.

**PREREQUISITES:** Basic knowledge on communication networks. (2 students)

**LTE NETWORK DESIGN AND PERFORMANCE ANALYSIS**

**Theoretical part :** Wireless networks; basic principles of LTE.

**Project:** Network coverage. Power budget. Uplink and downlink performance. Traffic dimensioning. Network optimization. Using a LTE simulator for performance analysis.

**PREREQUISITES:** Basic knowledge on wireless communications. (2 students)

**WIMAX NETWORK DESIGN**

**Theoretical part:** WiMax standards and specifications. Network topologies and IEEE standards.

**Project: Choice of particular site area. Topology analysis. Power budget. Traffic dimensioning. Performance analysis.**

**PREREQUISITES:** Basic knowledge on wireless systems. (2 students)

**AN APPLICATION OF WIRELESS SENSOR NETWORKS TO STREETLIGHT CONTROL AND MONITORING**

This project aims at developing a wireless sensor network for control and monitoring data transmission between lamp controllers and a segment (group) controller. The intern will be involved in network design and performance analysis under real operation, taking into account wireless links faults and possible interference of other wireless devices (operating in the unlicensed spectrum).

**Scope of work:**

Development of a wireless sensor network for control and monitoring data transmission between specialized controllers; Network planning and nodes configuration; Monitoring network performance under specific conditions; Development of control algorithms with respect to a path selection and interference management.

**Skill set:**

Knowledge on probability theory, computer networks and operating systems, fundamentals of telecommunications; wireless access networks. Experience in object-oriented programming. (2 students)

## BENCHMARKING METHODOLOGY DEVELOPMENT FOR ETHERNET SWITCHING DEVICES

This project aims at developing a benchmarking methodology for performance analysis of Ethernet switching devices in accordance with RFC 2889. The intern will be involved in the planning and execution of the test setup. Investigations encompass a variety of testing scenarios for throughput analysis, latency, etc. under specific traffic loads and patterns as well as frame format and sizes.

**Scope of work:**

Getting familiar with the RFC 2889 "Benchmarking Methodology for LAN Switching Devices"; Development of an experimental set-up including a personal computer(s) with an array of network interface cards and a device under test (DUT); Development of software applications (scripts) for traffic generation and benchmarking procedures.

execution; Performing measurements on real Ethernet switching devices under specific testing conditions; Results processing and reporting.

**Skill set:**

Knowledge on probability theory, teletraffic engineering, computer networks and operating systems. Experience in object-oriented programming. (2 students)

## M2M COMMUNICATIONS FOR CONTROL AND MONITORING OF REMOTE OBJECTS

This project aims at developing algorithms for data transmission to geographically distributed objects (devices) based on the RESTful web services.

**Scope of work:**

Getting familiar with the RESTful web services and M2M communications concepts; Design a technical solution for data exchange to remote devices; Development of algorithms and applications for data acquisition, processing and visualization.

Skill set:

Knowledge on fundamentals of telecommunications, computer networks and operating systems, principles of database management systems. Experience in object-oriented and web programming. (2 students)

## DATA SECURITY IN M2M COMMUNICATIONS

This project aims at developing methods and algorithms for secure data transfer to low-powered and low-computational remote devices (objects). In contrast to the majority of commercially available controllers, such devices do not employ secure data transfer protocols. The TCP/IP protocol stack is usually incorporated into external (supplementary) modules (e.g., GPRS/EDGE/UMTS modems, Ethernet modules, etc.), where secure communications do not often take place. Since the Web-services are getting more ubiquitous, the lack of "https" encryption is an issue.

**Skill set:**

Knowledge on fundamentals of telecommunications, computer networks and operating systems, communication systems security. Experience in object-oriented and web programming. (2 students)

## 2-FACTOR AUTHENTICATION CONTROL ALGORITHM FOR WEB APPLICATIONS

This project aims at developing 2-Factor authentication control algorithm, which grant user access to a particular web application and computational resources.

**Scope of work:**

Getting familiar with users' authentication mechanisms and public key infrastructure (PKI) technology. Comparison of known solutions. Development and implementation of a two-factor authentication scheme for web-based applications. Technical solution evaluation.

**Skill set:**

Knowledge on fundamentals of telecommunications, computer networks and operating systems, communication systems security. Experience in object-oriented and web programming. (2 students)

## INTRUSION DETECTION AND PREVENTION SYSTEMS

In this project the students are going to learn how IDS and IPS systems work. The process of monitoring network or system activities for malicious activities or policy violations and produces electronic reports to a management station will be investigated. The two main types of Intrusion detection systems - network based (NIDS) and host based (HIDS) intrusion detection systems will be simulated.

**PREREQUISITES:** Knowledge on computer networks and operating systems, fundamentals of telecommunications, programming. (2 students)

## DENIAL OF SERVICE ATTACKS AT DIFFERENT PROTOCOLS LAYERS

In this project students will have to acquire basic knowledge of main types of DoS attacks. The most commonly used DoS attacks (as for example SYN flood attack) will have to be simulated. Different models for defence techniques will be realized and investigated.

PREREQUISITES: Knowledge on computer networks and operating systems, fundamentals of telecommunications, programming. (2 students)

## CRYPTOGRAPHY ALGORITHMS SIMULATION BASED PERFORMANCE ANALYSIS

In this project students will have to learn main types of cryptoalgorithms. One whole cryptosystem (including symmetric and asymmetric algorithms) will have to be simulated and simulated. The search for the best solution offering the necessary protection against the data intruders attacks along with providing these services in time is one of the most interesting subjects in secure communications.

PREREQUISITES: Knowledge on computer networks and operating systems, fundamentals of telecommunications, programming. (2 students)

## ANALYSIS OF DENIAL-OF-SERVICE ATTACKS ON WIRELESS SENSOR NETWORKS USING SIMULATION

The aim of the project is an analyze of Wireless Sensor Networks (WSN) for performance evaluation. Denial-of-Service (DoS) attacks are one of the most serious threats due to the resources constrained property in WSN. This project will be focused on the impact of DoS attacks on the performances of Wireless Sensor Networks by using simulation model.

PREREQUISITES: Knowledge on computer networks and operating systems, fundamentals of telecommunications. (2 students)

## OPTICAL TRANSPORT NETWORKS

The aim of the project is to get knowledge on main features, design process and implementation of modern DWDM optical networks. Types of single mode fibres, dispersion characteristics, attenuation, power budget and dispersion management.

PREREQUISITES: Knowledge on fundamentals of Fiber Optics and Telecommunications. (2 students)

## COMPUTER-AIDED DESIGN OF CIRCUITS AND SYSTEMS FOR TELECOMMUNICATIONS

This topic is connected with the study, application and integration of existing Computer-aided design tools, as well as the development of new CAD tools, mainly for online applications. Tasks in computer-aided design of communication circuits and systems will be solved using the tools studied, integrated and/or developed. Example design projects could be power supplies for mobile devices, PCBs, sensors, nanocommunication devices, etc.

**PREREQUISITES:** basic knowledge of CAD tools – Cadence ORCAD, PSPICE, PCB design tools, basic web programming, etc. (2 students)

## PROTOTYPING CIRCUITS AND SYSTEMS ON PROGRAMMABLE LOGIC AND USRP PLATFORMS

A specification of communication circuit or system will first be defined by the student. Then he/she will have to develop a design of the communication circuit or system specified, in some of the environments VIVADO (XILINX), QUARTUS II (ALTERA) or GNU RADIO and then he/she has to prototype it on development boards with FPGAs (Zedboard, etc.) or USRP platforms. At the end verification has to be performed to check if the specification constraints are met. Example design projects could be coders, decoders, random number generators, modulators, demodulators, receivers, etc.

**PREREQUISITES:** some VHDL or Verilog notions, C++ or MATLAB programming (2 students)

## METHODOLOGY FOR REALIZATION OF GIVEN BER IN FSO SYSTEMS UNDER EFFECT OF NOISES

In this project, students will develop a method to offset the impact of various noises in the receiver of FSO systems. An important point in the method is finding the optimal angle of divergence of the laser beam. At this angle, the required transmitter's power obtains a minimum value.

**PREREQUISITES:** Optical communications, Optoelectronics, Antennas, Propagation of electromagnetic waves. (2 students)

## AVAILABILITY OF FSO SYSTEM IN THE PRESENCE OF RANDOM JITTER IN THE INITIAL LASER BEAM DIRECTION

In this project the students are going to study the availability of FSO (free-space optics) systems in the presence of random misalignments between the laser beam axis and the center of the receiving antenna. It utilizes a statistical model of the atmospheric visibility and a statistical model of the optical beam jitter. The numerical simulations are carried out.

**PREREQUISITES:** Optical communications, Optoelectronics, Antennas, Propagation of electromagnetic waves. (2 students)

## FACE EXPRESSION ANALYSIS BASED ON ACTIVE APPEARANCE MODELS

Recognition of emotional states is one of the key components for intelligent affective human computer interactions. Facial expressions recognition plays an important role in human communication. Faces are highly variable, deformable objects, and manifest very different appearances in images depending on pose, lighting, expression, and the identity of the person. Interpretation of such images requires the ability to understand this variability in order to extract useful information. The Active Appearance Model (AAM) enables us to fully automatically create a model of a face depicted in an image. The created models are realistic looking faces, closely resembling the original. Previous research projects have indicated that the AAM provides a good generalization to varying lighting / pose conditions as it is able to compactly represent these sources of variations. (2 students)

## AGE AND ETHNICITY ESTIMATION

There has been a growing interest in automatic age estimation from facial images due to a variety of potential applications in law enforcement, security control, and human-computer interaction. For example there are age limitations for driving a car, buying alcohol, cigarettes, video games, etc. which should be obeyed, but the human skills of age estimation are very limited. It is well known that the human-computer interaction varies for different age groups, thus a system which automatically adapts its interface to the age of the current user would clear this problem. However, despite advances in automatic age estimation, it remains a challenging problem. (2 students)

## HUMAN BODY MOTION/GESTURE RECOGNITION WITH RGB-D CAMERA (KINECT)

The computational implementation of human body gestures recognition has been a challenge for several years. Nowadays, thanks to the development of RGB-D cameras it is possible to acquire a set of data that represents a human position in time. Despite that, these cameras provide raw data, still being a problem to identify in real-time a specific pre-defined user movement without relying on offline training. However, in several cases the real-time requisite is critical, especially when it is necessary to detect and analyze a movement continuously, as in the tracking of physiotherapeutic movements or exercises. A full body gesture recognition system will be developed by tracking joints of head, neck, shoulder, arms, hands and legs. This tracking is done by Kinect motion sensor with OpenNI API. For gesture recognition data mining classification algorithms such as Naive Bayes and Back Propagation Neural Network will be used. (2 students)

## 3D OBJECT RECONSTRUCTION WITH STRUCTURED LIGHT SCANNER

Recently, one of the central issues in the fields of Photogrammetry, Computer Vision, Computer Graphics and Image Processing is the development of tools for the automatic reconstruction of complex 3D objects. Among various approaches, one of the most promising is Structured Light 3D scanning (SL) which combines automation and high accuracy with low cost, given the steady decrease in price of cameras and projectors. SL relies on the projection of different light patterns, by means of a video projector, on 3D object surfaces, which are recorded by one or more digital cameras.Automatic pattern identification on

images allows reconstructing the shape of recorded 3D objects via triangulation of the optical rays corresponding to projector and camera pixels. Models draped with realistic photo-texture may be thus also generated, reproducing both geometry and appearance of the 3D world. In this context, subject of our research will be a synthesis of state-of-the-art as well as the development of novel algorithms, in order to implement a 3D scanning system available at the Computer vision laboratory. (2 students)

## ADAPTIVE IMAGE ENHANCEMENT

The image enhancement methods are available that increase the visibility of one portion, aspect or component of an image, though generally at the expense of others whose visibility is diminished. Most image analysis procedures attempt to extract only the "important" information from the image. An example would be to identify and count features in an image, reducing the amount of data from perhaps a million bytes to a few dozen, or even a single "Yes" or "No" answer in some quality control, medical, or forensic applications. The image processing for purposes of enhancement can be performed in either the spatial domain (the array of pixels comprising our conventional representation of the image) or other domains, such as the Fourier domain (spectral domain). Examples of each of these approaches were be used, to replace brightness values to expand image contrast or to smooth noise by kernel averaging or median filtering, or 2D LMS linear filtration. Related techniques can be used to perform further enhancements. In this aspect, subject of our research will be the development of algorithms for local or global adaptive image enhancement using Matlab or Visual Studio environment. (2 students)

## ADAPTIVE IMAGE INTERPOLATION

To reduce the degradation effects of interpolated images using well known non-adaptive methods for image interpolation, more sophisticated adaptive image interpolation methods were proposed in the recent years. These methods are based on edge patterns prediction in the local area (minimum 4x4), an adaptive high-order (bicubic or spline) interpolation with contour filtration or chosen of different type low-order interpolation (zero or bilinear), depending on the analysis in a small local area of images. On this base the optimal selection of thresholds for dividing into homogeneous and contour blocks is made and the interpolation type is changed adaptively. In this aspect, subject of our research will be the development of algorithms for local or global adaptive image enhancement using Matlab or Visual Studio environment. (2 students)

## DEVELOPMENT OF MATLAB WEB SERVER

The Matlab Web Server enables you to create Matalab applications that use the capabilities of the World Wide Web to send data to Matlab for computation and to display the results in a Web browser. The Matalab Web Server depends upon TCP/IP networking for transmission of data between the client system and core. In this aspect, subject of our research will be the development of networking software using Matlab Compiler SDK. MATLAB Compiler SDK™ extends the functionality of Matlab Compiler to let you build C/C++ shared libraries, Microsoft® .NET assemblies, Java® classes, and Python® packages from Matlab programs. These components can be integrated with custom applications and then deployed to desktop, web, and enterprise systems. (2 students)

## CONTENT-BASED IMAGE RETRIEVAL IN HETEROGENEOUS DATABASES

Content based image retrieval (CBIR) means that images can be searched by their visual content. For example, you can pick landscape image of mountains and try to find similar scenes with similar color and/or similar shapes. Traditional way to find images is to first assign keywords to images and then use textual query to find needed images. Writing keywords to hundreds or thousands of image is a tedious and error prone task. Using CBIR can images be analyzed by different methods which represent different aspects of visual information of images. Image searching and image archival can be greatly speeded up using automatic image analysis tools. Content based image retrieval (CBIR) is a two phase process: first images are analyzed and inserted to the image database and after that they can be queried. Query is issued by giving an example image or by starting with random images from current images in database. Query continues so that images can be marked as positive or negative samples to refine search and to get better results. (2 students)

**MONITORING AUDIENCE'S VISUAL ATTENTION BASED ON EYE TRACKING**

Keeping audience attention is more important and more difficult than grabbing audience attention. A one-way presentation is one of the worst possible ways of transferring information from person to person. It requires discipline and effort to simply sit and listen passively to someone speak for any length of time. Eye movements are potential indicators of an individual's visual attention. The objective of this task is to develop a method and algorithm for visual attention measurement. An audience reaction module can acquire audience reaction data such as how long eyes are engaged on a specific sign. (2 students)

**PAIN DETECTION ALGORITHM BASED ON FACIAL EXPRESSION ANALYSIS**

Current methods of assessing pain depend almost entirely on verbal report such as clinical interview or questionnaires of the patients. Pain being a symptom that can neither be felt nor seen, poses a major problem for the medical personnel involved in pain management since there are no accurate objective measures to establish the extent of pain the patient is suffering from when using a remote assistive medical system. The verbal report grading pain has obvious discrepancies, especially when it comes to children or people with limited ability to communicate (i.e. the mute, mentally impaired, or patients having assisted breathing). When designing a medical assistive system measuring pain in an efficient way is of great importance. The task of this project is to develop an algorithm for automatic pain recognition (i.e. pain/no pain presence in human) based on facial expression analysis. (2 students)

**MENTAL TASK RECOGNITION BASED ON EEG SIGNALS**

Neural activity in the brain can be measured by non-invasive devices such as nuclear magnetic resonance (NMR) or functional magnetic resonance imaging (fMRI), functional near-infrared spectroscopy (fNIRS), positron emission tomography (PET), Electroencephalograph (EEG), and so on. By analyzing these measured data, diseases and mental states can be recognized. So there have been many researches on the field of brain activity sensing and brain-computer interface (BCI), or brain-machine interface (BMI), and human machine interaction (HMI). The objective of this work is to develop a method and algorithm for distinguishing simple mention tasks such as: 1. Relaxing as much as possible, 2. Calculating multiplication mentally, 3. Letter-composing, 3. Imagining rotation of a 3-D object, 4. Imagining writing a number in order. (2 students)