King Saud University
College of Engineering
Electrical Engineering Department **Semester: 381**

Senior Design Project Proposal Form

Project # C1

Project Title: Photonics-Based Remote Breath/Respiratory Tracking System

Professor(s) Name(s): Dr. Saleh Alshebeili and Dr Majid Altamimi

Number of Students: Two

Students Qualifications

1. Knowledge of digital signal processing
2. Knowledge of radar concepts
3. Excellent skills in programming

Statement of Problem

Breath monitoring is one of the cricuial vital sign in most health care premises. This requires expensive monitoring equipments, highly qualified experities in addition to annoying physical contact to patients. The wireless monitoring of such critical signals is a smart solution that overcomes these drawbacks. The Utra wide band (UWB) signals have shown promising advances in such applications due to immunity against multipath interference, high resolution and low radiation emission. Moreover, the long tranmission rabges of these signals using photonic technologies allows signal distribution over several kilometers as well as the centerlaizerd generation and analysis of breathing signals.

Objectives

The main objectives of this project are as follows:

1. Conducting literature review to characterize the breath signals and determine the suitable radar signal for breath monitoring,
2. Writing codes for radar signal generation and echo analysis for breath monitoring,
3. Developing of experimental measurement setup that demonstrates the integrated fiber wireless system,
4. Investigating both segments, i.e. communication and distribution segments,
5. Evaluating the developed montoring system. This includes echo signal detection and analysis.

Technical Approach

Literature review and model programming will be conducted using KSU electronic library and Matlab software, respectively. Hardware implementation will be conducted using devices, equipment, and software available at RFTONICS CNL-lab.

Expected Deliverables

A prototype of remote breath rate monitoring.

King Saud University
College of Engineering
Electrical Engineering Department **Semester: 381**

Proposal Form

Project #C2

Project Title: **Design of Software-Defined Global Navigation Satellite System (GNSS) Receiver**

Professor(s) Name(s): **Ibrahim Elshafiey & Abdel Fattah Sheta**

Number of Students: **Two**

Students Qualifications:
Basic knowledge of communication engineering.

Statement of Problem
Global navigation satellite systems are currently used in various applications. Most of the developed systems have fixed hardware components, which are tailored to a particular GNSS system and a particular engineering application. This project aims at implementing software-defined based tools to develop a system that can be used with various GNSS constellations in a variety of applications.

Brief Description of the Project
The focus of this proposal is directed to developign a software-defined receiver that can identify the location based on GPS and Galileo systems. The developed system will be investigated to obtain high accuracy position identification. Obtained accurate timing signals will used to synchronize the clock of various systems at different locations.

Objectives
The objective of this project

(1) Investigate developments in GNSS
(2) Design a software defined GNSS receiver.
(3) Enhance the efficiency of the system.
(4) Conduct tests on the developed system.
(5) Identify applications in the Kingdom of the developed system.

Technical Approach and Expected Deliverables

The steps to achieve these objectives:

- Phase I: Students will investigate and study the subject of software defined GNSS receiver.
- Phase II: Students will design system modules.
- Phase III: Students will validate and optimize the design using simulation.
- Phase IV: Students will manufacture the modules.
- Phase V: Students will investigate the applications the can be based on the developed system.

King Saud University
College of Engineering
Electrical Engineering Department **Semester: 381**

Senior Design Project Proposal Form

Project # C3

Project Title: Design of Software-Defined Satellite Communication System

Professor(s) Name(s): Abdel Fattah Sheta & Ibrahim Elshafiey

Number of Students: Two

Students Qualifications:
Basic knowledge of Communication Engineering

Statement of Problem
Satellite systems provide efficient platforms that can be configured for specific missions, taking advantage of their mobility. With extended civilian and military applications, re-configurability of the satellite communication system is required. Software-defined tools can be used to enhance performance of satellite communication and provide systems that can be adapted to various application.

Brief Description of the Project
The focus of this proposal is directed to the communication between the earth station and the satellite communication subsystem, which is essential to carry telemetry, and payload data. The basic communication subsystem consists of a receiver and a transmitter on both the satellite and the ground station. The project aims at developing simple and reconfigurable communication system that can be adapted to various applications in the Kingdom.

Objectives
The objective of this project

(6) Investigate requirements of satellite transceiver systems
(7) Design a software-defined transceiver system.
(8) Increase the efficiency of the system.
(9) Conduct tests on the developed system.
(10) Identify applications in the Kingdom of the developed system.

Technical Approach and Expected Deliverables

The steps to achieve these objectives:

- Phase I: Students will investigate and study the subject of satellite communication systems.
- Phase II: Students will design system modules.
- Phase III: Students will validate and optimize the design using simulation.
- Phase IV: Students will manufacture the modules.
- Phase V: Students will investigate the applications the can be based on the developed system.

King Saud University
College of Engineering
Electrical Engineering Department **Semester: 381**

Graduation Design Project Proposal Form

Project # C4

Project Title: Design and Implement Real-Time Spectrum Sensing and Accessing.

Professor(s) Name(s): Dr. Majid Altamimi and Prof. Saleh Alshebeili

Number of Students: Two

Students Qualifications

- Good understanding of wireless communications and signal processing.
- Good programming skills in MATLAB and Python.
- Basic knowledge in communication spectrum.

Statement of Problem

In the era of the dramatic growth of wireless technologies, the RF spectrum becomes fully occupied and cannot accommodate the demand for the RF bands by new wireless technologies. Therefore, the dynamic spectrum access is invented to overcome this problem by allowing more than one wireless network to share the RF bands. However, sharing the bands introduces a new problem, which is how to enable the sharing with minimum interference and transmission collision.

Brief Description of the Project

This project is designed to give the students an overview on the cutting edge technologies in the wireless communications. The students need to understand the current regulation for the RF spectrum and the anticipated future regulation. In addition, they are expected to design and implement dynamic spectrum sensing then develop spectrum access protocols based on the result from the implemented spectrum sensing.

Objectives

This project is intended to:

1) design and implement dynamic spectrum algorithms;
2) examine the performance of these algorithms; and
3) develop spectrum access protocol.

Technical Approach and Expected Deliverables

The project is expected to deliver the above objectives by conducting an academic research and write a short survey on the proposed algorithms for dynamic spectrum sensing. Then, the students have to design their experiment using their programming skills to examine some attractive sensing from the literature. Finally, the students will be encouraged to deploy their full real-time system to sense and access the spectrum.

King Saud University
College of Engineering
Electrical Engineering Department **Semester: 381**

Graduation Design Project Proposal Form

Project # C5

Project Title: Design of Sub-THz antennas for 5G high speed wireless communication

Professor(s) Name(s): Dr. HamsakuttyVettikalladi and Dr. Abdel Fattah Sheta

Number of Students: Two

Students Qualifications

Knowledge of electromagnetic theory and basic knowledge of antennas

Statement of Problem

Over the last few years, wireless data traffic has drastically increased due to a change in the way today's society creates shares and consumes information. This change has been accompanied by an increasing demand of much higher speed wireless communication anywhere, anytime. In particular, wireless data rates have doubled every eighteen months over the last three decades. Following this trend, wireless Terabit-per-second (Tbps) links are expected to become a reality within the next five to ten years. In this context, Terahertz Band communication is envisioned as a key wireless technology to satisfy this demand, by alleviating the spectrum scarcity and capacity limitations of current wireless systems, and enabling a plethora of long-awaited applications in diverse fields. The THz Band is the spectral band that spans the frequencies between 0.1 THz and 10 THz. The very large bandwidth provided by the THz Band opens the door to a variety of applications in 5G Cellular Network links,WLAN,WPAN etc, which demand ultra-high data rates and allows the development of a plethora of novel applications in classical networking scenarios as well as in new nanoscale communication prototypes. Some of these applications can already be foreseen and others will undoubtedly emerge as technology progresses. Antenna is the fundemental element in all these communication system. Low profile, wideband, high gain and low cost antennas are needed for this purpose.

Brief Description of the Project

In the most recent years, wireless communication networks have been facing a rapidly increasing demand for mobile traffic along with the evolvement of applications that require data rates of several 10s of Gbit/s. In order to enable the transmission of such high data rates requires ultra-high bandwidths beyond 20 GHz. Such an amount of unregulated spectrum can be identified only in the sub-THz to THz frequency range of >~ 0.1THz-10THz in general (Sub THz range is 0.1 THz to 1THz). Systems operated at those frequencies are referred to as THz communication systems. The very large bandwidth provided by the THz Band opens the door to a variety of applications which demand ultra-high data rates. Some of the potential applications are in 5G cellular networks, ultra high speed Wireless Local Area Networks (LAN), ultra high speed Wireless Personal Area Network and secure wireless terabit communication. The technology enabling small integrated transceivers with highly directive, steerable antennas becomes the key challenges at THz frequencies in face of the very high path losses. This proreject plans to study the technology and design compact antennas suitable for Sub-THz frequency operation. Because of the atmospheric losses and oxygen absorption phenomena around 300GHz band, it is ideally suitable for the next generation extra high speed (24Gb/s) short range wireless communication after 2020. The speed is expected to be more than 10 times faster than 60GHz indoor communication systems which are available in the market soon.

Objectives

1) Study the THz waves and technology
2) Finding the best technology to design antenna around 300 GHz, because low frequency technology is not applicable at high frequencies.

Technical Approach and Expected Deliverables

Phase I: Students will study sub-THz waves and its frequency spectrum
Phase II: Study the Potential Applications of sub-THz technology
Phase III: Study the different antenna designing technologies by literature review
Phase IV: Design sub-THz antenna using CST Microwave studio simulation software.

King Saud University
College of Engineering
Electrical Engineering Department **1st Semester: 381**

Graduation Design Project Proposal Form

Project #C6

Project Title: Simulation of Focused Ultrasound (FUS) Therapy for Hyperthermia

Professor Name: Dr. Mubashir Alam and Dr. Ibrahim Elshafie

Number of Students: Two

Students Qualifications: Students should be from the electromagnetic and signal processing area and strong willingness to learn the physics behind ultrasound and its use in hyperthermia.

Statement of Problem

This project will model the treatment of cancer/tumors using Focused Ultrasound (FS) therapy. The thermal necrosis of a tumor etc caused by an ultrasonic transducer will be modeled, and try to optimize the process to maximize tumor ablation and minimize tissue damage. The process can be modeled using COMSOL Multiphysics and Matlab.

Brief Description of the Project

Focused ultrasound (FUS) hyperthermia is a non-invasive technique for cancer/tumor treatment that does not require any incisions or percutaneous insertions. Ultrasound hyperthermia uses focused ultrasound waves to destroy targeted tissue. During this procedure, an ultrasound transducer delivers mechanical energy to tissues, resulting in temperature increase and thus cell death. This project will try to model the thermal treatment using FUS therapy. Thermal effects caused by an ultrasonic transducer are modeled, and then try to optimize the process to maximize tumor ablation and minimize tissue damage. The process can be modeled in COMSOL Multiphysics.

Objectives

(1) Learning the physics behind ultrasound
(2) Learning COMSOL Multiphyics environment
(3) Modeling FUS using COMSOL by incorporating tumor and ultrasound transducer model
(4) Obtain the heating pattern induced by FUS
(5) Optimization frequency/intensity of ultrasound based on focusing and heating pattern

Technical Approach and Expected Deliverables

This project will cover modeling FUS therapy using COMSOL. The deliverables will be a realistic model and simulation/optimization results of thermal effects induced by FUS treatment.