Athens Information Technology(AIT), Greece.

Optical Network Design and Planning

The traffic carried by core optical networks as well as the per-channel interface rates required by IP routers are growing at a remarkable pace year-over-year. Optical transmission and switching advancements have so far satisfied this huge traffic growth by delivering the content over the network infrastructure in a cost and energy efficient manner utilizing to the maximum extent the capabilities of optoelectronic and photonic subsystems and the available bandwidth of deployed optical fibres. However, we are rapidly approaching capacity limits of single-mode fibres and the scientific and industrial telecommunications community foresees that the growth capabilities of conventional WDM networks coming to an end.

At present, industry is hard-pressed to identify how future networks will continue to scale in capacity, energy consumption, and economic viability. The technology of space division multiplexing (SDM) is the only solution with the scaling potential to meet future demands. However, there is still a large technological chasm between the transport solution and the SDM network implementation. The EU FP7-ICT INSPACE project (http://www.ict-inspace.eu/) proposes a novel networking approach enabled by the development of novel spatial-spectral switching nodes as well as new network planning algorithms and control plane extensions enhanced with the space dimension.

Interested students may undertake one or more of the following projects:

- Designing and Implementing Algorithms for Optical Network Planning in MATLAB
- Designing a Data Extraction Module for an Optical Network Planning Tool in MATLAB
- Designing a Graphic User Interface (GUI) for an Optical Network Planning Tool in MATLAB
- Designing a GUI for a Quality of Transmission Tool for SDM networks in MATLAB

Required knowledge

Knowledge of MATLAB.

Supervising Professor: Ioannis Tomkos,

http://www.ait.gr/ait_web_site/faculty/itom/tomkos.html

Digital Signal Processing strategies in long haul optical communication systems

Current fiber optical networks are facing a bandwidth exhaustion due to exponentially increasing traffic demands. This fact renders the upgrade of legacy optical networks based on wavelength division multiplexing (WDM) absolutely necessary. A major concern in the design of high-speed, high-spectral efficiency, optical communication systems is how to deal with the distortions that the signal experiences as it travels through the fiber as an electromagnetic wave. The removal of the signal distortions takes place at the receiver's side and it is called digital signal processing (DSP).

In the frame of the INSPACE research project (www.ict-inspace.eu) Athens Information Technology researchers are developing algorithms for correcting the signal as part of the DSP block after transmission through different fiber types (i.e, Standard Single Mode Fiber (SSMF) and Few Mode Fiber (FMF)). These algorithms are just one small part of the DSP but a vital one for recovering the signal after transmission.

Interested groups of students will undertake the following:

1. Understand the transmission system model
2. Familiarize themselves with the concept of the correction algorithms
3. Test and report on the performance of the correction algorithms using Matlab

At the end of the project, the students will have gained an insight into some of the state-of-the-art algorithms currently used in optical communication systems and in the wireless communication systems. This knowledge will be a useful introduction into high-demand research topics, triggering their interest in the related fields.

Required knowledge

Optical Communications, Matlab

Supervising Professor: Ioannis Tomkos,

http://www.ait.gr/ait_web_site/faculty/itom/tomkos.html

Network Design

In modern high-speed networks, traffic from multiple customers is usually merged together and sent on the same path though the network. Current research wants to create future networks that are highly flexible and programmable, so that each customer's application can be handled separately, which results in a better service to the customer. The challenge is to create network intelligence that can handle each customer's connection request as it comes in, and do so in a smart, optimal way.

AIT's NOC Group is currently involved in one multi-partner project that attempts to push high-speed optical networks into the programmability paradigm: Application-Centric IP/Optical Network Orchestration or ACINO (www.acino.eu). To that end, a core component of the research is network modeling and optimization using net2plan (www.net2plan.com), which uses the Java programming language. This tool hopes to become de-facto standard for network modeling in academia and industry.

A prospective intern or interns would be involved in one or more of these research project-related activities:

1. Adding components and changing the graphical user interface in net2plan. Visualization in network design is highly beneficial to the network planner, so this task should be seen as more than "prettying up" the user interface. Successful additions and alterations will be offered to the creators of the (free and open source) net2plan tool to be included in future versions, and a reference to the code creator requested.

2. Creating new methods and functions in net2plan to facilitate fast network prototyping and optimization. Some procedures in network design are used repeatedly, so creating their code to be re-used later is prudent and beneficial. Similar to 1., quality code will be offered to the creators of net2plan for integration.

3. Exploration of network optimization methods currently needed in the ACINO project. This task involves close collaboration with the head of the project, and requires knowledge, or the desire to learn, network algorithms, their implementation and testing, and reporting of the results.

In all cases, the intern(s) will be given a small reading project to familiarize themselves with the general and knowledge specific to the project. Guidance and assistance will be provided by the project head. At the end of the project, the student will have acquired knowledge of the current and future high-speed networks that carry the world's Internet traffic. A final report will be submitted at the end of the internship; high-quality results may be included in future scientific publications.

Preferred knowledge

- Java programming language
- Data networks

Supervising Professor: Ioannis Tomkos,

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"Database Server development for measuring throughput of Software Defined Radios"

Description: The goal of this project is to develop a database server for the B-WiSE Lab's existing Software defined Radios (USRP 2953R hardware from National Instruments). The database will open two ports and deliver packets to the Primary and Secondary users (PU-SU) of a Cognitive Radio system and will also be able to take care of the performance monitoring by providing feedback to the user on demand. The database will return to a Linux terminal the provided throughput, the successful packet and error rates of the PU and SU in real time. The connectivity to the database of the PU-SU users will be implemented in a provided LABVIEW environment.

"Real-time Video streaming Implementation to existing over-the-air transmission platforms"

Description: Software-Defined Radios (SDRs) are becoming more and more popular these days in the field of wireless communication. Results of research studies for illustrative purposes are more attractive to the wide audience when video steaming is used instead of constellation diagrams and complex charts. The goal of the project is to add this extra feature to the existing radio transmission testbed using any programming language with available tools from the web.

"Antenna Load tuning controller with a graphical user interface"

Description: The goal of this project is to use C or Python to program an off-the-shelf microcontroller board in order to build an analog antenna load tuning subsystem. The hardware will be provided and it will include a controller such as n STM32F4 evaluation board or a Raspberry Pi and a QUAD DAC evaluation module (EVAL-AD5501 / 04EBZ). The main controller board will have to control the DAC's output voltages through its Serial Peripheral Interface (SPI) in order to tune the antenna loads (varactor diodes) to certain capacitances. All functionalities shall be controlled through an Ethernet connection and a user friendly graphical interface.

"Real-Time Wireless Sensor Network Platform"

Description: The goal of this project is to deploy a multi-hop mesh FireFly sensor network in order to perform specific functions. The FireFly is a low-cost wireless sensor network platform capable of data acquisition, processing & multi-hop mesh communication. Each FireFly node features an IEEE 802.15.4 transceiver capable of short-range (50-100m) data communication with a maximum raw data rate of 250Kbps. An 8-bit microcontroller processes data from (optional) on-board light, motion, audio, temperature and acceleration sensors. Each node has an SD Flash card slot for add-on data acquisition and storage modules. In addition, FireFly nodes feature a low-power AM/FM radio receiver to periodically acquire a time synchronization pulse.

"Collaborative sensing and wireless transmission algorithm implementation in Python"

Description: Python is a widely used, high-level, open-source, general-purpose, interpreted, dynamic programming language. Its design philosophy puts emphasis on code readability, and its syntax allows programmers to express concepts in fewer lines of code than would be possible in languages such as C++ or Java. It supports multiple programming paradigms, including object-oriented, imperative and functional programming or procedural styles. It features a dynamic type system and automatic memory management and has a large and comprehensive standard library. In recent years, Python has turned into a mainstream programming language that constantly gains popularity, due to its:

- Supper-effective memory management
- Terrific error handling
- Better package management
- Efficient - easily implemented parallel processing tools.

The goal of the project is the conversion of existing pieces of code from Matlab to Python and the implementation of new ones in Python. The specific codes are used for collaborative sensing techniques in sensor networks and for the transmission of data via software-defined radio USRP's (National Instruments). At the end of the project, the efficiency of the algorithms will be tested in the lab via over-the-air radio transmissions.

"Simulation of LTE-A MU-MIMO techniques"

Description: Multi-User Multiple Input / Multiple Output (MU-MIMO) is an important element of LTE-A, as well as of any future wireless communication system. The aim of this project is to implement and demonstrate the gains of using MU-MIMO precoding techniques, using an implementation of the LTE-A standard in the LTE Vienna Simulator platform. The project requires good knowledge of the Matlab programming language, including its Object Oriented extension, and basic understanding of wireless communication systems. The results of this project will be considered for submission to a relevant international conference.

" LSA Band Manager simulation"

Description: The Licensed Shared Access (LSA) concept has gained in popularity due to the continuously increasing demand for wireless services and the limited availability of spectrum. Under this concept, a Licensee and an Incumbent operator can share the Incumbent's radio resources under strict sharing rules. The various architectures developed (including from 3GPP and FP7-project ADEL) require the introduction of a new network node, the LSA Band Manager, which controls the allocation of the shared resources to the Licensee operators, based on metrics such as the operator's location, bandwidth requirements, transmission power, etc. The aim of this project is to build a multi-operator system simulator that is coordinated by an LSA Band Manager, using the LTE Vienna Simulator platform. The rules followed by the Band Manager will be given as an input. The project requires very good knowledge of Matlab, including its Object Oriented extension, as well as basic understanding of the wireless communication systems architecture. The outcome of the project will be considered for submission at a relevant international conference.

Supervising Professor: Constantinos Papadias
http://www.ait.gr/ait_web_site/faculty//papadias/papadias.html

Project Proposal

Title

Design and Development of Content Management Applications Using Oracle CM SDK

Supervising Professor

Prof. Ioannis T. Christou, http://www.ait.gr/ait_web_site/faculty/ichr/christou.html

Description

Students will get acquainted and learn the architecture and Application Programming Interface (API) of the popular Open Source Oracle CM SDK for developing web-based Content Management applications. In the course of this project, students will learn how to install and configure the SDK, and subsequently use it to create a web application that will allow users to upload scanned documents to the content management system with appropriate (configurable) associated meta-data. The application will also have appropriate Information Retrieval capabilities (i.e. search features) using the CM SDK built-in features.

Prerequisites

As the CM SDK is entirely written in Java, good knowledge of the Java programming language is a pre-requisite. Knowledge of the JEE (Java Enterprise Edition) API is a plus.

Expected Results

The result of this work will be a running web app that will implement all the features contained in the project description, plus detailed documentation of the software design and implementation.

Project Proposal

Title

Development of Select Games with Java swing

Supervising Professor

Prof. Sofoklis Efremidis, http://www.ait.gr/ait_web_site/faculty/sefr/efremidis.html

Description

The project concerns the development of a number of select games (mostly of adventure, competition) as standalone applications using Java swing. The games will be used in the context of educational courses that are offered by AIT.

Prerequisites

Good knowledge of Java and Java swing.

Expected Results

The result of this work will be a suite of games that will be used in educational settings.

Project Proposal

Title

Data population and retrieval from graph based databases

Supervising professor:

F. Talantzis http://www.ait.gr/ait_web_site/faculty/fota/talantzis.html

Description

Students will get acquainted and learn the basics of graphs and corresponding applications using the Neo4J graph database. He will learn the basics of Linux, the client-server paradigm and the way someone interfaces with a REST API. More importantly he will get the chance to populate a graph-based database with data that resemble an individual and his network (much like a twitter user and its followers) and detect useful statistics e.g. people with larger network, influencers (people with many followers and in the network of many people).

Prerequisites

Basic use of Linux and understanding of basic concepts in REST APIs

Expected Results

The result of this work will be a full installation of an Ubuntu Linux Server, the Neo4J software/database with dummy data and reporting tools in the form of graph representations.