TIEJ601 Postgraduate Seminar in Information Technology

Short presentations
Academic year 2011-2012

Network management optimization for self-organizing radio networks

GETA PhD student

Sergey Chernov

Enrolled in June 2011

UNIVERSITY OF JYVÄSKYLÄ

PhD Thesis Work

- Thesis title: "Network management optimization for self-organizing radio networks"
- Format: Collection of articles
- Suprevisor: professor Tapani Ristaniemi
- Work status: Literature review
- Expected completion date: 1/2015 – 9/ 2015
- Research work background: Data mining for problem/fault detection, e.g. cell outages, and diagnosis in cellular networks. Optimization of mobility robustness.
- Advanced LTE/LTE-A system level simulators. Applied numerical computing environment MATLAB.
- Research methodology: design science research

Tuomo Sipola

- Topic: High-dimensional data analysis using diffusion methods
- Collection of papers
- Supervisors: Amir Averbuch, Tapani Ristaniemi
- Status: 30% done, 1 conference paper
- Expected 2014
- Background: data mining, anomaly detection, diffusion map
- Contribution: multiple cluster analysis, root cause of data behavior
- Expected results: improved method for root cause analysis, proof for a related method

Analytical and Numerical Modelling of Paper Web Dynamics in Paper Making Process

Tytti Saksa

Department of Mathematical Information Technology
University of Jyväskylä

Postgraduate Seminar in Information Technology,
September 5, 2011

Status of the Ph. D. Thesis

- One and a half years behind – two and a half years ahead
- Expected dissertation, December 2013
- Format: collection of articles (5 in total)
- supervisors: Prof. Pekka Neittaanmäki, Prof. Nikolay Banichuk (RAS), Prof. Raino Mäkinen
- One article published, one conference paper published, one conference paper accepted
- studies: 57 ECTS / 60 ECTS completed

Objectives and Expected Results

- Research objectives:
  - Stability analysis of the moving web system.
    - Critical conditions.
- Expected results:
  - Basic research.
    - Increase understanding of the physical phenomenon.
  - Real time simulations.
  - Direct application in paper making process.
- Methods: Mathematics (analysis) and Spectral Methods (e.g., Galerkin method), other numerical methods

For Further Reading

📕 N. Banichuk, J. Jeronen, M. Kurki, P. Neittaanmäki, T. Saksa and T. Tuovinen.
On the limit velocity and buckling phenomena of axially moving orthotropic membranes and plates.
International Journal of Solids and Structures. 48:2015-2025, 2011. *doi:10.1016/j.ijsolstr.2011.03.010*.

📕 T. Saksa.
Dynamic behaviour of an axially moving viscoelastic panel in contact with supporting rollers.
In Proceedings of ECCOMAS Thematic Conference on Computational Analysis and Optimization. Eds. S. Repin, T. Tiihonen and T. Tuovinen. University of Jyväskylä, 2011.

📕 N. Banichuk, J. Jeronen, T. Saksa and T. Tuovinen.
Static instability analysis of an elastic band travelling in the gravitational field.
Journal of Structural Mechanics. Accepted manuscript.

Free / Libre / Open Source Software (FLOSS) Evolution: Maintainability of Emacs and other systems

Supervisors: Jussi Koskinen and Timo Männikkö.

Format: Collection of 5–7 articles.

Status:

- 49 ECTS completed with grade-point average of 5.0.

- A couple of papers are work-in-progress, nothing published yet.

- Original plan to finish in 2011, now postponed to 2013.

What?

- Software maintenance becomes harder over time unless some anti-regressive measures are applied.
- Many FLOSS-projects are old but easy to modify $\Rightarrow$ effective maintenance practises.
- *Find out what practises help to make software maintainable.*

Why?

- Used techniques are difficult to apply to other projects because they have not been studied very much.
- By generalizing time-proven maintenance practises it is possible to lengthen the software life span.

How?

- Collect data from public systems (SCM-systems, mailing lists, source code archives, ...).
- Observe the maintenance processes of old FLOSS projects.
- Keep an eye on situations where tacit knowledge is applied.

Needs:

- Mostly time.

"Though a program be but three lines long, someday it will have to be maintained."

- The Tao of Programming

Free / Libre / Open Source Software (FLOSS) Evolution: Information for Program Comprehension in Linux and other systems

Supervisors: Jussi Koskinen and Timo Männikkö

Format: Collection of 5–7 articles

Status:

- 49 ECTS completed with grade-point average of 5.0
- A couple of papers are work-in-progress, nothing published yet
- Original plan to finish in 2011, now postponed to 2013

What? Collect information that helps understanding some unusual or bad decisions made in FLOSS projects.

Why? To maintain a software product safely, one must understand why something was done in a particular way.

How? Empirically study the history of some projects using data from version control systems, mailing lists and other sources. Try to find rationale behind "interesting" decisions.

Contribution? Finding and analyzing past mistakes makes it easier to avoid them in the future.

Problems: I've moved 2 times within the last year, so my progress has been slow. I have compensated for this by postponing my expected finishing time.

Some reasons for ugly / special code:
- Need to work-around hardware/firmware limitations/bugs
- Need to follow specification   - Need to maintain compatibility
- Left-over debugging code   - Plain design mistake
- Need for speed   - Overly clever code:

```
Date: Tue, 22 Jan 2008 01:57:03
From: Linus Torvalds <torvalds@linux-foundation.org>
To: Rusty Russell <rusty@rustcorp.com.au>
Subject: Re: [PATCH 0/6] RFC: Typesafe callbacks

I bow down before you.

I thought I had done some rather horrible things with gcc built-ins and
macros, but I hereby hand over my crown to you.

As my daughter would say: that patch fell out of the ugly tree, and hit
every branch on the way down. Very impressive.

All hail Rusty, undisputed ruler of Ugly-land.
```

TIEJ601 Intro Presentation - Niko Kotilainen

Current topic:

"Social Networking in a Mobile Peer-to-Peer Context"
(A collection of papers)

Supervisors:

- **Prof. Tapani Ristaniemi**
- **Ph.D. Jani Kurhinen**

Status:

- **All the required papers have been published.**
- **Currently writing the introduction.**
- **Expected to have a draft ready within 3 months, with the defence sometime in 2012.**

TIEJ601 Intro Presentation - Niko Kotilainen

Background

- **Research done since 2003 at a P2P research group.**
- **A wide array of scientific results:**
  - *Research Tools*
  - *Algorithms*
  - *Measurements*
  - *Middleware Prototypes*
  - *Application ideas / prototypes*

PhD Thesis Work

Postgraduate student

Fedor Chernogorov

Enrolled in March 2011

UNIVERSITY OF JYVÄSKYLÄ

- Preliminary title: *"Advanced Performance Monitoring in Future Mobile Networks"*

- Format: Collection of articles

- Suprevisor: professor Tapani Ristaniemi

- Current status: Preparation of articles, and ongoing research work

- Expected completion date: second half of 2015

- Background and keywords: Performance monitoring in cellular mobile networks on the basis of advanced data mining techniques in conjunction with the concepts of Self-Organizing Networks and Minimization of Drive Tests.

- Ongoing research activities: Detection of Sleeping Cells in LTE networks. (Reference: F. Chernogorov, J. Turkka, T. Ristaniemi and A. Averbuch, "Detection of Sleeping Cells in LTE Networks Using Diffusion Maps", International Workshop on Self-Organizing Networks (IWSON), VTC 2011 Spring, Budapest, Hungary, May 15-18, 2011)

- Dynamic system level mobile network simulator, analysis of the high dimentsional data in MATLAB.

- Research methodology: design science research

Web Server Log Analysis: Anomaly Detection and Quality of Service Guaranteeing

Thesis Format: Collection of papers.

Supervisor: Prof. Timo Hämäläinen, Tapani Ristaniemi and Jyrki Joutsensalo.

Status: Methodology design and analysis by using existing data mining data set from DARPA.

Expected finishing time: 30 September 2014.

Background and main scientific contribution: Main contribution of this work will address the problem of protecting web applications and providing QoS guaranteeing through the analysis of the HTTP requests.

Expected Result: Anomaly detection applying neural network approach with high quality of service to provide both user and provider interests.

Research methodology/tools: Neural Network and MatLab.

General/special needs: Training/Mentor.

Present by Sukanya Khanom

JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

Enhancing Wireless Communication Systems with Different Signal Processing Methods

TIEJ601 Postgraduate Seminar in Information Technology

Advisor : - Prof Timo Hamalainen

Department of Mathematical Information Technology,
Faculty of Information Technology,
P.O. Box 35, FI-40014 University of Jyväskylä,
FINLAND.
05th September 2011.

Enhancing Wireless Communication Systems with Different Signal Processing Methods

- About the topic : - Relates to air interface communication techniques of wireless broad band networks (yet to be finalized). Publication are being prepared, ready for submission and under review.

- Format : - Please refer to the appendix.

- Supervisors : - Profs Timo Hamalainen, Jyrki Joutsensalo, Tapani Ristaniemi

- The status of the thesis : - First phase of the research (Based on BSS and Gradient Principles) is in the winding up stage (Results are to be published.). Discussions are being held for the second phase (Likely to be on pulse shaping and signal localization.). Whole work relating to the PhD is expected be finished by 31 December 2013.

- Background : - Research is motivated by ever increasing demand for higher data rates. Always exposed to the industry. Latest and future anticipated needs of the industry and standardization organizations are also taken into account as much as possible.

- Main contribution : - Strengthening the signal detection capabilities of the air interface communication techniques (Techniques belong to families of OFDM and CDMA are targeted).

- Expected results : - Better performance than the standard systems and / or techniques are targeted. Trade offs between different parameters are always tried to be properly handled.

- Research methodology : - Development of a original solution, verification by simulation, analysis of results on comparative basis. Tools : - MatLab, c++ (optional).

- Needs : - I have received all the necessary resources. I would like to receive them until the end.

Thank you..........!

Presented by : M.G.S. Sriyananda

Appendix : - Structure of a Compilation Dissertation

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Title

Abstract

Acknowledgements

List of abbreviations and definitions

List of original publications

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  2.5 Theory synthesis

3. Research contribution

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  3.2 Article 2 results

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4. Discussion

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  4.2 Practical implications

  4.3 Reliability and validity

 4.4 Recommendations for further research

Summary

References

Original publications

Always Best Connected (ABC) IP Network - Jari Kellokoski

- Collection of papers, supervised by Timo Hämäläinen

- Studies are almost complete, research side has lots of things to do. One paper approved. Two papers under research. Still high hopes on completing at the end of 2012 or early 2013

- Research problem: how to have the best possible IP connection in heterogenious network

- Results may lead to contribution to IETF and 3GPP standards such as Mobile IPv6 and Evolved Packed Core

- Work is done in co-operation with faculty's Lipa project
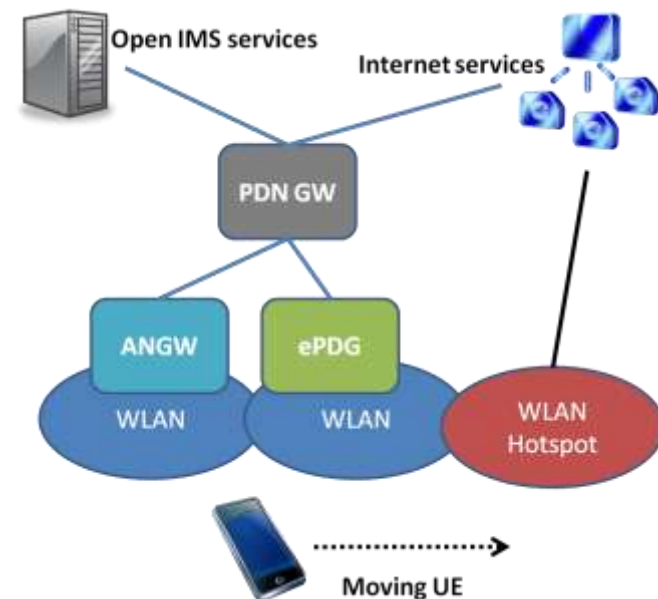
Sauli Ruuska:

- ▶ Topic: Real-Life Optimization Problems with Multiple Objectives and Uncertainty
- ▶ Format: Collection of papers
- ▶ Supervisor: Professor Kaisa Miettinen
- ▶ Status: 1 journal article submitted
- ▶ Background: Nonlinear optimization, multiple-criteria decision making
- ▶ Contribution: to the theory of multiobjective optimization
- ▶ Methodology: Basic real analysis and algebra, some statistics
- ▶ Tools: C++, MATLAB/Octave

Influence of human factors and affective technology in utilitarian mobile applications

Erkki Kurkinen

+358400247680

- dissertation supervisor: prof Pekka Neittaanmäki, prof. Rauno Kuusisto
- format: monograph
- status of this plan: draft research plan
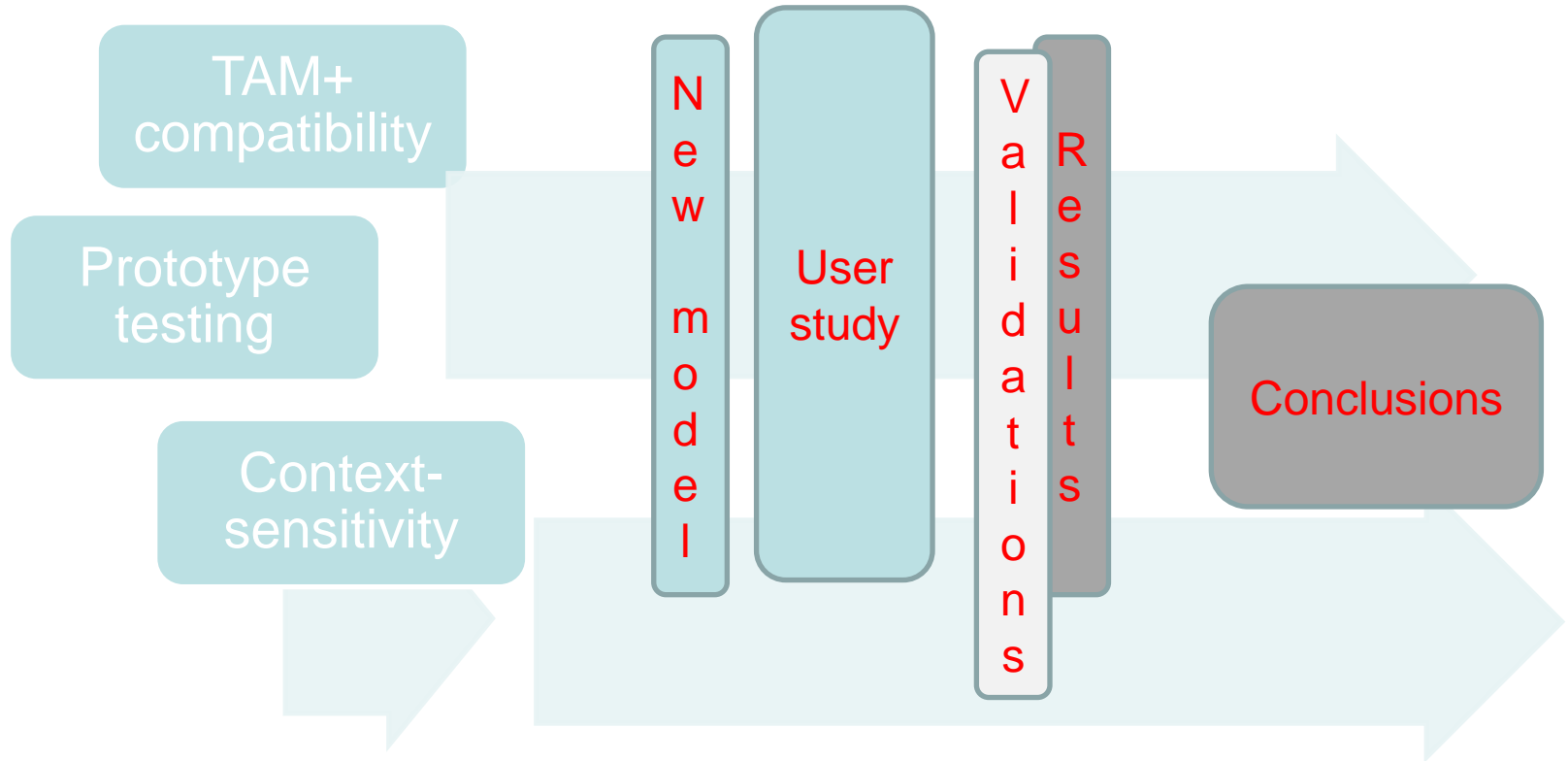- time schedule: started Jan 2010,   ready   ~2012

JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

Introduction

- User behaviour in accepting new technology (computers, tv, IT-systems) has been studied since 50-60's

- Mobile technology user studies done since 80's

- Traditionally there have been spesific research methods for different user types (i.e. hedonic users, utilitarian users)
  - PEOU=percieved ease of use
  - PU= percieved usability
  - CA =cognitive absorption
  - TAM, TAM2 =technical acceptance model

- Currently, models for customer acceptance in mobile applications are being developed as well in the community

- Utilitarian use (like police) is assumed to get closer to the hedonic use (consumer) = one of the hypotheses in this research

- In this research the goal is to create new methods for technology acceptance for utilitarian users having elements from existing models from both user types and use in empirical tests to prove hypotheses

Sketch of a new acceptance model development

TAM+ compatibility

Prototype testing

Context-sensitivity

New model

User study

Validations

Results

Conclusions

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Research goals

- **Research questions:**

- Do the traditional variables of TAM (perceived ease of use, perceived usefulness) combined with variables for compatibility (compatibility with existing practices, compatibility with experience, compatibility with values) explain technology acceptance of the Finnish police

- What is the relationship between the *context of work activities* and using the mobile technology in police work?

- Are there geographical differences inside the same officer ranks in the mobile technology acceptance?

- Are there differences between the officer ranks in the mobile technology acceptance?

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Type of research & Methods

- Confirmatory case study
- Questionnaire to Finnish police (ca. 400 answers)
- Factor analysis + SEM
- tools to be used: Webropol, PASW, MPlus

Oleksandr Bilozerov:

- Topic: Information Security Culture in ICT Small and Medium Sized Enterprises

- Format: Collection of papers (5-6)

- Supervisors: Prof. Hannakaisa Isomäki,Antti Auer

- Status of PhD: First paper will be published in October 2011 (IRIS 34 Selected Papers publication)

- Expected finishing time: 2013-2014

- Methodology: Grounded Theory

My PhD (1/2)

"Memory-saving optimization algorithms for systems with limited memory "
(collection of papers)

- **Research fields**
  - *Computational Intelligence Optimization*
  - *Software Engineering*

- **Supervisors**
  - *Ferrante Neri, Adj. Prof - Ernesto Mininno, PhD*
  - *Tuomo Rossi, Prof. - Raino Mäkinen, Prof.*

- **International collaborations** *(NTU, Singapore)*
  - *Meng-Hiot Lim, Ass. Prof.*
  - *Yew-Soon Ong, Ass. Prof.*
  - *Ponnuthurai Nagaratnam Suganthan, Ass. Prof.*
  - *Rammohan Mallipeddi, PhD*

My PhD (2/2)

"Memory-saving optimization algorithms for systems with limited memory "
(collection of papers)

- **Status of PhD research activities**

  3 journal papers published + 1 journal paper submitted (currently under review)

  4 conference papers published on proceedings

- **Status of study plan**

  55/60 credits

- **Other Activities**

  Visiting PhD student at NTU, Singapore (Feb-Mar 2011)

  Participation to IEEE Symposium Series in Computational Intelligence (Apr 2011)

  Supervision of MSc thesis of Fabio Caraffini (Erasmus Program, May-Sep 2011)

  2 more journal papers + 1 book chapter submitted (not to be included in the thesis)

  Possibly 2/3 more papers to be submitted by December 2011

- **Expected finishing time: December 2011**

Memory issues in CI

What if we need to perform the optimization online on an embedded system with limited hardware?

- **compact DE algorithms**
- **memory-saving MC**

Approximation through Interpolation in Nonconvex Multiobjective Optimization
by
Markus Hartikainen

- Supervisor: Prof. Kaisa Miettinen
- Format: Collection of (5) articles
- Timetable: to preevaluation next week
- Contribution: A PAINT method for interpolating between Pareto optimal solutions in nonconvex multiobjective optimization → Faster iterations (through approximate solutions) when solving comp. exp. problems with interactive methods (justified with examples)
- Tools: IND-NIMBUS® software framework

PhD study summary

- Topic: Visual Analytics (working title)
- Format: collection of papers
- Supervisors: Tommi Kärkkäinen, Anneli Heimbürger and Sami Äyrämö
- Started in 1.1.2011
- Status: 1st paper published
- Expected finishing time: in 2015
- Application areas: Energy production and Information security
- Goal: method development

Object Recognition for Augmented Reality Applications on Mobile Platforms

Matti Eskelinen matti.j.eskelinen@jyu.fi

- **Format:** Collection of papers
- **Supervisors:** Tommi Kärkkäinen, Tuomo Rossi, Ville Tirronen
- **Background:** The current popular computer vision methods are based on rigorous mathematical and statistical treatment of images, and typically consider only small image regions or collections of regions in isolation. While there is nothing wrong with rigorous mathematics, my theory is, that the results and efficiency of these methods can be improved by considering the high-level structure of the scene, narrowing down the search space. Augmented reality was chosen as the application area, as it is a dynamic field where computer vision and scene analysis have a lot to offer.
- **Contribution:** Developing new and/or modified, efficient object recognition methods based on higher-level scene understanding and applying them to augmented reality on mobile devices.
- **Research methodology:** Formulating methods, evaluating their usefulness and efficiency systematically, and presenting the results.
- **Status:** Started 2010, expected finishing time 2014; so far, the author has studied the state of the art, and worked on a method for analyzing the scene structure. The first version of the method is nearly complete, and the author is planning experiments for obtaining results to be published in a journal paper. One conference paper has been submitted, but was not accepted, as the results were not yet conclusive. However, the feedback was positive, and the author was encouraged to continue the work.

Muaed M. Kabardov

The topic of the PhD thesis (monograph):

"Numerical simulation of wave propagation in quantum waveguides in the presence of electric and magnetic fields"

Research group

    Pekka Neittaanmäki, Professor, Dr., The head of the group

    Lev M. Baskin, Professor, Dr.

    Boris A. Plamenevsky, Professor, Dr.

    Tuomas Puurtinen, PhD student

    Muaed M. Kabardov, PhD student.

The work is focused on studying the two phenomena:

a) electron resonant tunneling in 2D and 3D (i.e. two- and three-dimensional) quantum waveguides of variable cross-section;

b) polarization of electron beams in quantum wires (waveguides) in magnetic fields.

The phenomena can be of use for building various devices in nano- and microelectronics. Resonant tunneling can serve for key devices, transistors, amplifiers. Polarized electron beams (consisting of electrons with spins of the same direction) are of much current interest in connection with development of Spintronics (a new electronics trend), in particular, such beams are used as information storage. It is important to develop mathematical modeling and numerical simulation for the above phenomena.

Research problems and goals

1. Numerical simulation of resonant tunneling in a quantum waveguide of variable cross-section

We consider 2D and 3D waveguides that have two narrows and are described by the Helmholtz equation. For electrons with energy between the first and second thresholds, we have to solve the problem in an infinite domain to find the scattering matrix and derive from it the transition coefficient (with respect to the narrow's diameters and the electron energy), the resonant energy, at which tunneling occurs, and the width of the resonant peak – the so-called quality factor.

2. Numerical calculation of the constants in the asymptotic formulas

In the paper "Asymptotic theory of resonant tunneling in 3D quantum waveguide of variable cross-section" (by L. Baskin, P. Neittaanmäki, B. Plamenevsky, and O. Sarafanov, SIAM Journal for Applied Math., v.70 (2009), no. 5, 1542-1566), asymptotic formulas were obtained for the basic characteristics of resonant tunneling. The formulas contain

several constant coefficients that were not calculated in the paper. To get from the asymptotics not only qualitative but also quantitative results on the tunneling, it is necessary to find the mentioned coefficients. To do that, we have to solve numerically a number of boundary value problems for the Helmholtz equation in bounded and unbounded domains with corner points at the boundary.

3. Comparison of the efficacy of asymptotics and numerical simulations with respect to parameters of the waveguide

Generally, it can be predicted that numerical calculations will become inefficient as the diameters of the waveguide's narrows decrease and the resonant peak turns out to be "too sharp"; however, at such a condition the asymptotics should become more reliable. On the other hand, the asymptotics will give way to the numerical method as the narrows' diameters increase. This leads to the question which diameters could be considered as "sufficiently small"; in other words, where does the asymptotics work in a proper way? To this end we have to compare the results obtained by the asymptotic and computational

methods independently of one another, and, if needed, elaborate a generalization of the numerical algorithm which involves asymptotics.

4. Numerical simulation of the spin-polarization for electron beams

We plan to generalize the methods for resonant tunneling elaborated earlier to apply them to the analysis of the processes in the waveguide where the electron flow is controlled by external magnetic field. The members of the group have suggested a new method of electron flow polarization in quantum waveguides of variable cross-section and elaborated an asymptotic description of the main characteristics of the process. We are going to find numerically the characteristics, compare numerical results with asymptotic ones and clarify the bands of parameters of the systems where asymptotic and numerical approaches are efficient. The situation is more complicated than that related to resonant tunneling (in particular, because here we deal with magnetic field absent in our preceding studies).

Progress of the work

Almost a half of the planned work is done. Algorithms for calculating the constants in asymptotic formulas for resonant tunneling in a 2D waveguide with two narrows have been implemented. The scattering matrix of the waveguide and its basic characteristics has been numerically found and compared to the results of the asymptotic formulas. The comparison and used techniques are displayed in the article "Asymptotic and numerical studies of resonant tunneling in 2D quantum waveguides of variable cross-section" (by L. Baskin, M. Kabardov, P. Neittaanmäki, B. Plamenevskii, and O. Sarafanov), which has been prepared for submitting to a journal.

It is expected to finish the remaining part in a year and half, i.e. the thesis should be ready by the end of spring of 2013.