Educational Course and Tutorial on Software Development of Mobile Applications for the Intel® Atom

Oleg Granitchin, Vladimir Kiyaev

Saint-Petersburg State University

9-th Conference of Open Innovations
Community FRUCT
1-st Regional MeeGo Summit Russia-Finland
AMICT 2011 Workshop

Petrozavodsk, Russia, 25-29 April 2011

SPRINT
SPbSU-Intel Laboratory

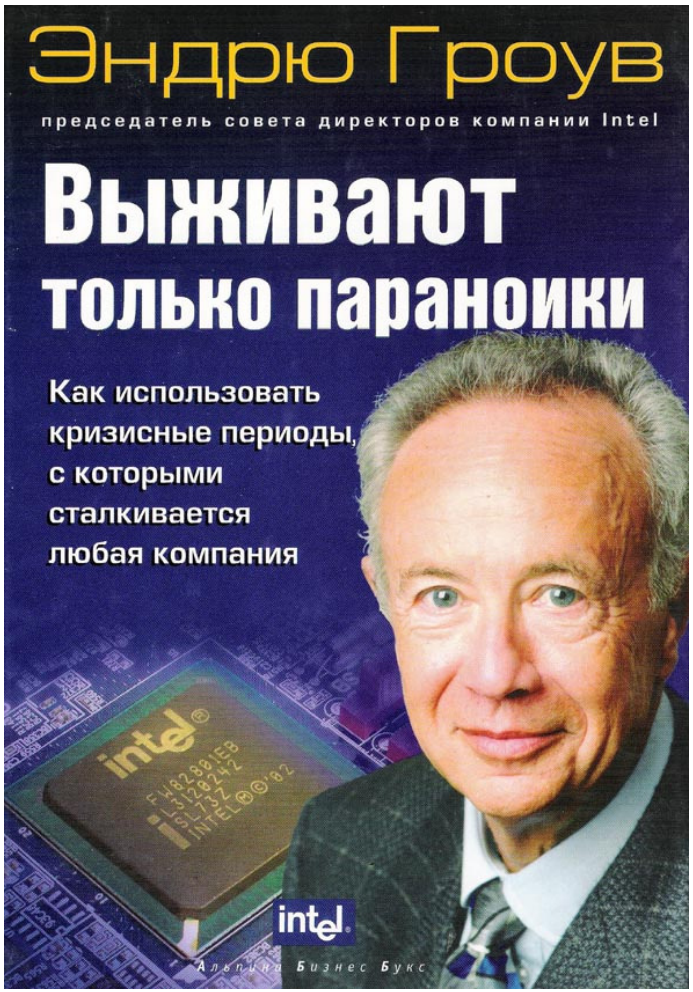
MeeGo-activity in St. Petersburg State University is successfully cultivated within the activities of the **System Programming and Information Technology Laboratory (SPRINT Lab)**.

Lab activity is supported by the Russian branch of Intel Corporation

Origins…

The idea to create educational and research laboratories in Russian major universities was made by vice-president of Intel Andrew Grove in the preface of his wonderful book "Only the Paranoid Survive"

Such laboratories have been established in Nizhny Novgorod, Moscow, St. Petersburg, Sarov, Novosibirsk



Origins…

System Programming and Information Technology Laboratory (SPbSU - Intel) was created in Saint-Petersburg State University in October 2003 with the direct participation of the Intel CEO Paul Otellini

"Intel Corporation do not need engineers - we have many brilliant engineers. We do not need programmers - we have the best programmers around the world. We do not need managers - America provides managers throughout the world.

We are in need very much of Researchers, which could push Intel to new achievements!

From a speech in the Assembly Hall of St. Petersburg State University, 02.10.2003

SPRINT Lab 2010-2011 activities

Projects:

- Learning & Research
- Scientific & Research
- Organizational

Activities:

- Physic's Day
- Participation in Expo 2010
- Lab SPRINT Festival and Week
- Contests of "Atomosfera - 2010, 2011"
- St. Petersburg Autumn Robo Cup 2010 and Regional stage of Robotics 2011
- Summer and winter mobile technology theme schools

Conferences, reports, articles, monographs

Learning courses and materials (including MeeGo Tutorial)

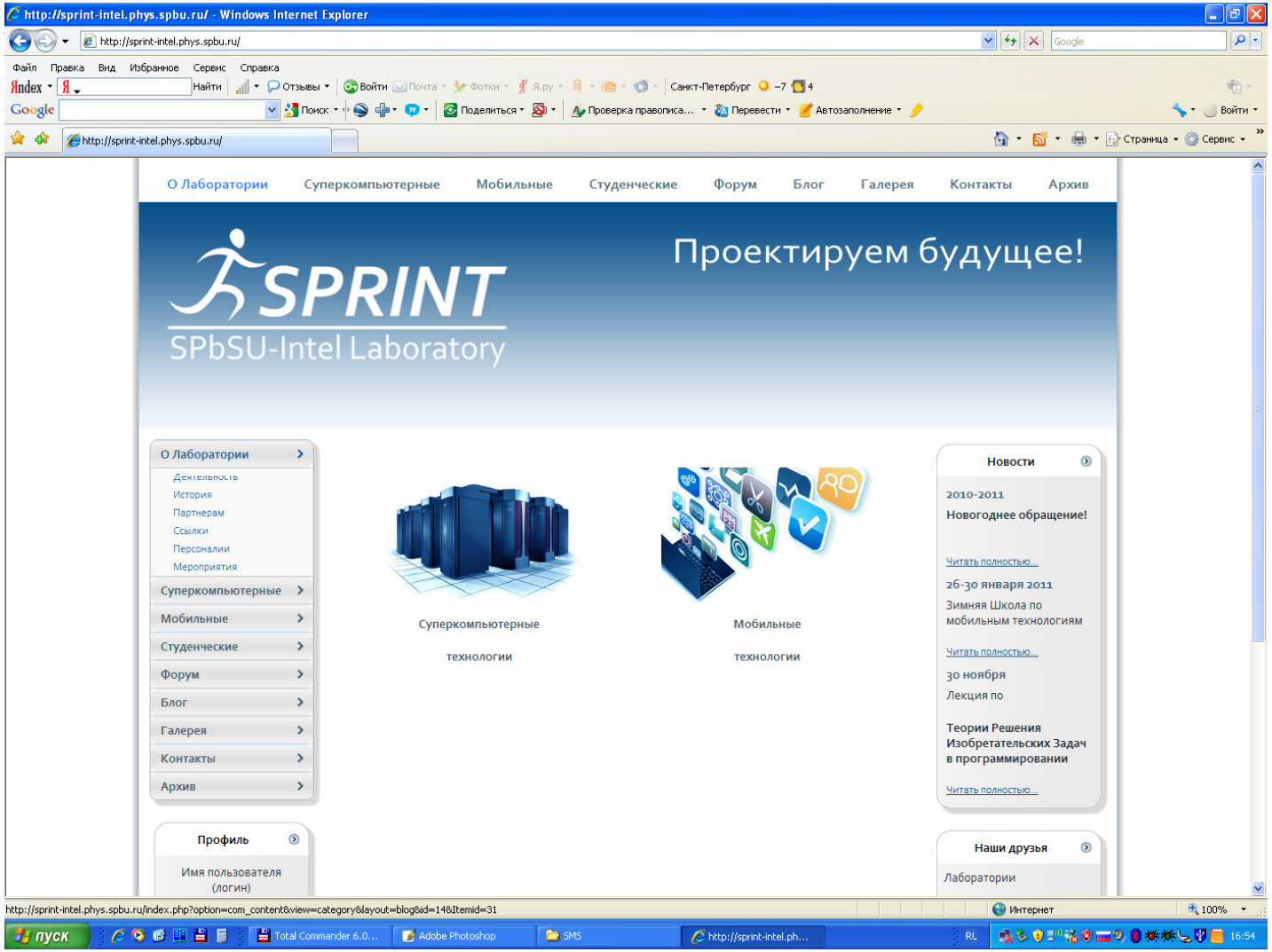
System Programming and Information Technology Laboratory (St. Petersburg State University – Intel)

High Performance Computing

Prof. S.A.Nemnyugin

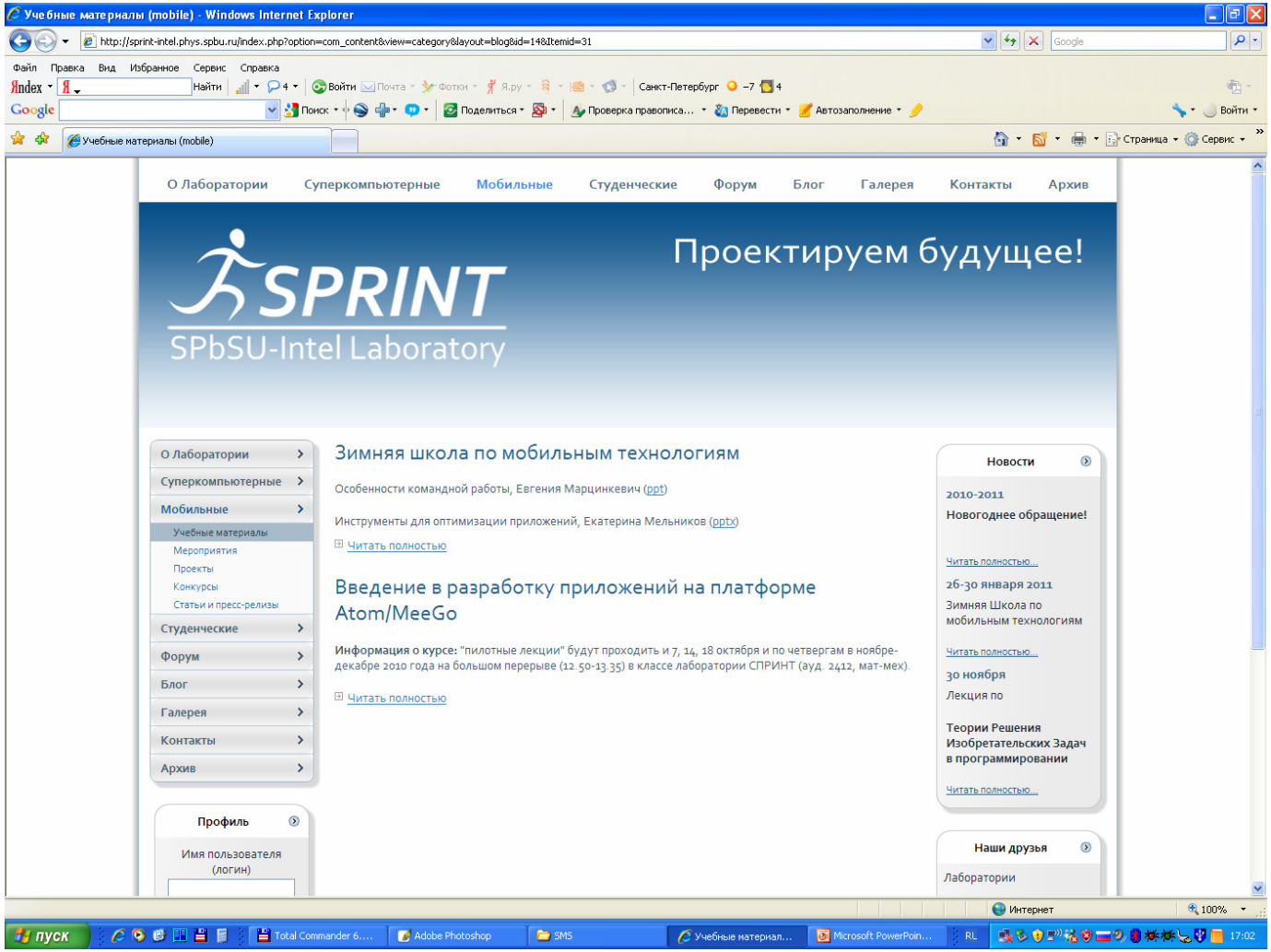
Mobile Technology

Prof. ONGranitchin



More than 150 students, graduate students and young scientists had successful probation in the SPRINT Laboratory

Mobile technologies direction



Project: Organization of competition "Atomosfera-2010" for the North-West region of Russia

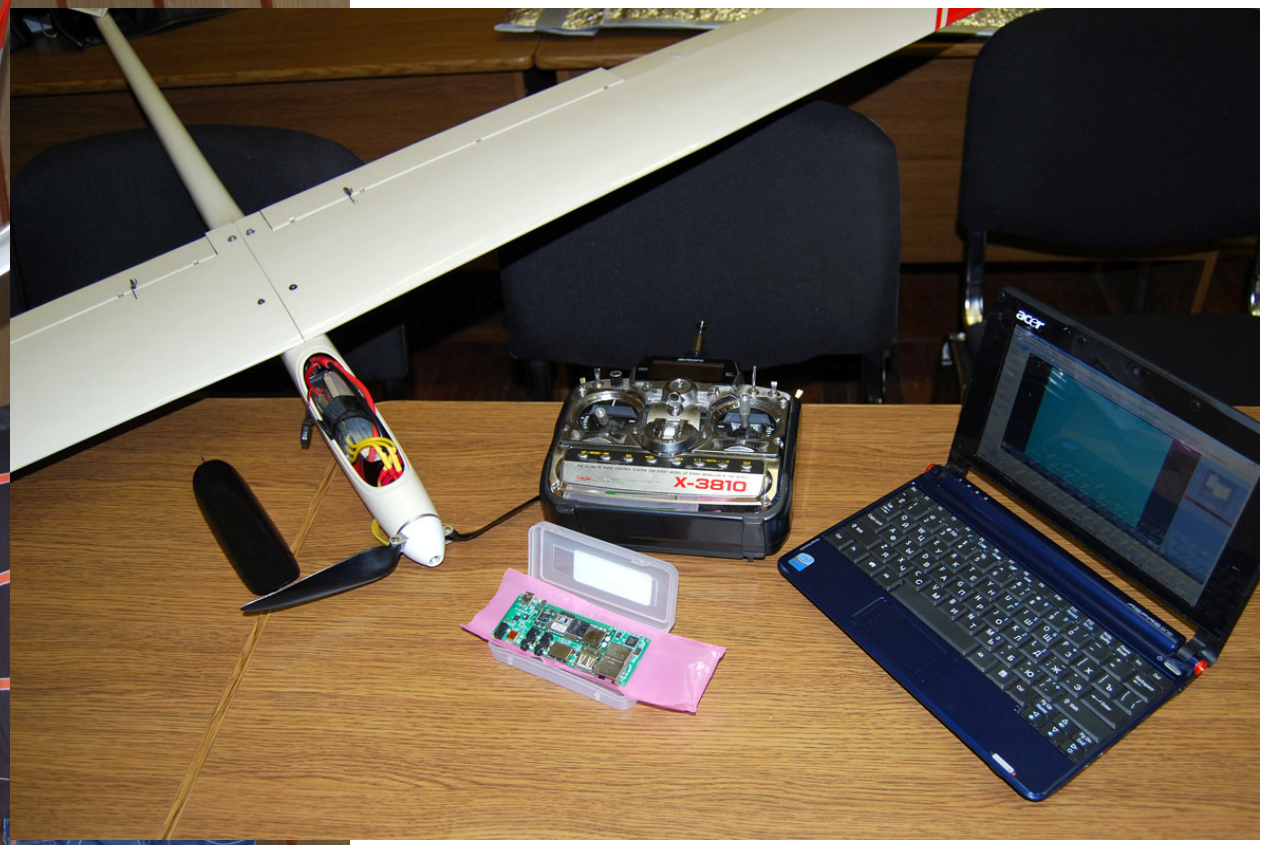
Principals – I.Odintsov, O.Granitchin, V.Kiyaev

Project: Multi-agent system, implemented by the example of the unmanned aerial vehicles interaction

Principal – prof. O.Granitchin

Exterior view of the UAV

Control system

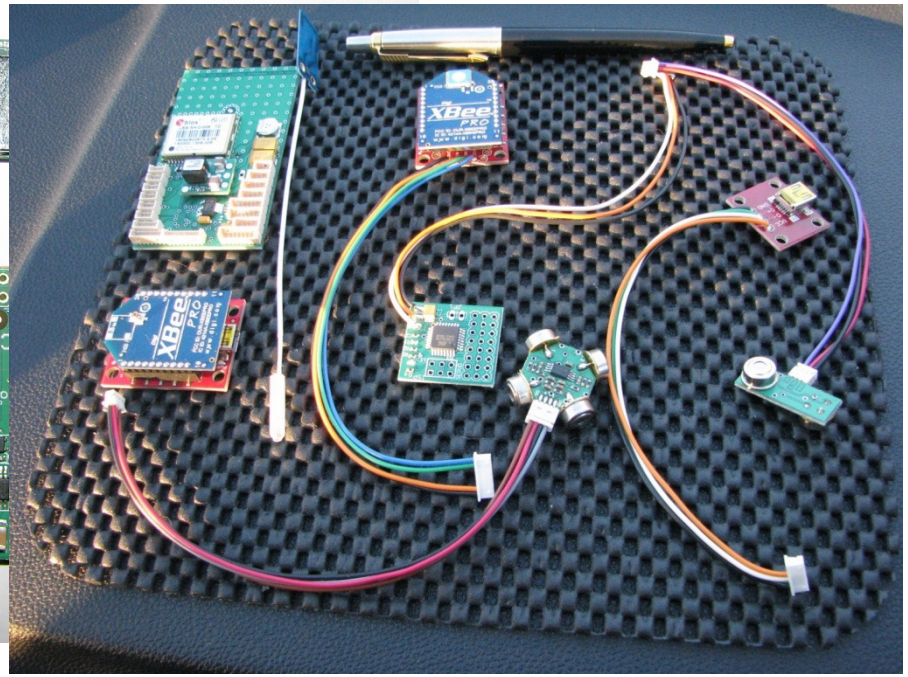


Project: Multi-agent system, implemented by the example of the unmanned aerial vehicles interaction

Base mobile station

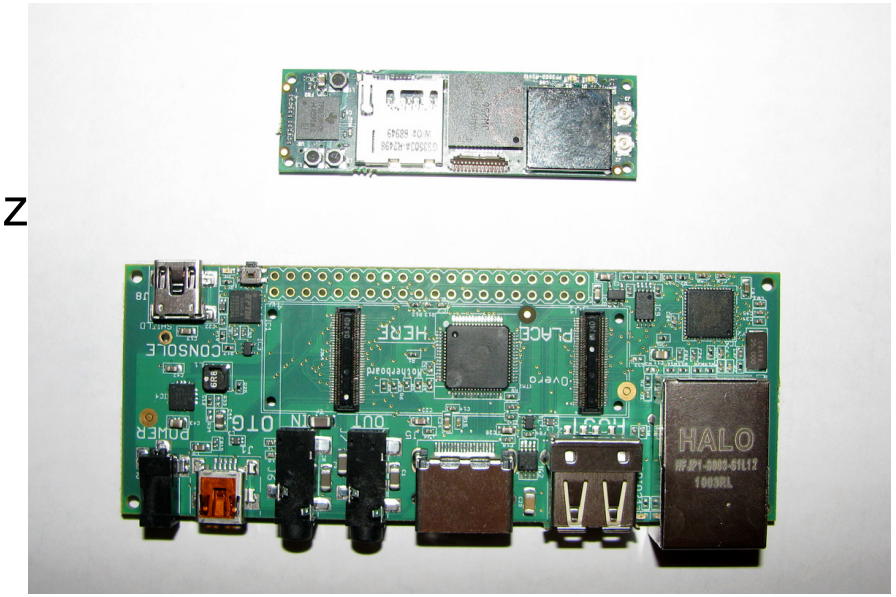
On-board microcomputer

Autopilot system Papapazzi



On-board microcomputer

- Gumstix Overo Air
- Size: 17 мм x 58 мм x 4,2 мм
- Processor ARM Cortex-A8 600 Mhz
- 256 MB RAM
- Built-in Memory 256 MB
- NAND Flash slot for micro SD card
- 27-pin slot for micro video camera
- OC Linux
- Connection parameters: 2,4 GHz c 802.11 a/b/n (wi-fi)
- GPRS with GSM modem



Project: Multi-agent system, implemented by the example of the unmanned aerial vehicles interaction

Airframe «PAPRIKA»

- Length: 1200 мм
- Wing span : 2006 мм
- Wing area: 35,8 dm^2
- Maximum flying weight: 2000-2100 gr.
- Actual load: 600 gr.

In 2010 the project received support from "START" program. Project participants N.Granitchina and K.Amelin have got the grants of the President and the Russian Federation Government

Scientific project yield

Adaptive Autonomous Soaring of Multiple UAVs Using SPSA

Cathrine Antal, Oleg Granichin, Sergey Levi

Abstract— This paper presents a new algorithm for maximizing the flight duration of a single UAV (Uninhabited air vehicles) and UAVs group using the thermal model developed by Allen at NASA Dryden.

As a first step, we suggest a new algorithm based on SPSA for quick and precise detection of the center of a thermal updraft where the vertical velocity of the air stream is the highest. The method takes into account the unstable behavior of the updraft dynamics and the drift of its center in time.

Then, a multi-agent system for joint flight of multiple UAVs is presented. A protocol for UAV communication providing effective information exchange on updrafts location is proposed. A sufficient condition for the protocol to be effective is deduced theoretically. We show that the energy consumption of each UAV could be significantly reduced using the multi-agent approach.

I. INTRODUCTION

Large birds and glider pilots commonly use updrafts caused by convection in the lower atmosphere to extend flight duration, increase cross-country speed, improve range and conserve energy. UAV may also have the ability to exploit updrafts to improve performance. Results obtained in paper [1], [2] show that a UAV with nominal endurance of 2 hours can fly a maximum of 14 hours using updrafts during the summer and a maximum of 8 hours during the winter.

Extending the endurance of UAVs flight is currently an area of major research interest, because they are very popular for aircraft missions that would be dangerous or too boring for human pilots. And such missions as military surveillance or commercial usage as atmospheric satellites need extremely long edurance of UAV flight.

This paper is based on two key ideas for UAV soaring improvement. The first one is using simultaneous perturbation stochastic approximation method (SPSA) [3], [4], [5], [6] for thermal updraft center detection. This method allows to treat the updrafts center drift effectively because of the tracking properties of SPSA shown in papers [7]. It also helps to compensate the effect of horizontal wind considered as systematic noise as shown in work [8], [9].

The second idea is to use a group of UAVs instead of one unit for more effective location of updrafts and thus increasing average expected flight time for each UAV [11].

The multi-agent approach and the distributed decision making systems have become particularly popular because of their robustness and effectiveness when applied to problems with incomplete data solving. There are different approaches for gathering and processing information by autonomous agents. Each of them can only observe the environment partially and upload the observation data into a shared pool. All agents have their goals and values used in decision making. They have some beliefs and expectations regarding their complex surroundings that help them to define their behavior on each step.

Such distributed models are successful because there is no central control node with the major load on it. Each agent has its role that is changed with time. It helps to develop more flexible and fault-tolerant systems because of distributed data storage and traffic minimization between players.

Numerous frameworks for multi-agent cooperation have been developed recently and some simulations of multi-UAV cooperation have been made. Very significant results were obtained in Carnegie Mellon University where a group of UAVs flied together [10] in order to detect and destroy all RF emitters within a test area . Using Bayesian approach they built a distribution map of their expectations for each cell of the terrain. Then they corrected their paths in order to collect more information on unvisited regions and obtain the full picture of emitters locations. Similar results were obtained in the task of weapons detection by UAVs. The high potential of the multi-agent approach in tasks of this sort was proved in works both theoretically and by simulation results.

In our research a multi-agent system of UAVs was used for flight endurance maximization. Each UAV flies through its waypoints and gathers information on thermals location. Due to the multi-agent approach all agents can obtain the whole picture of updrafts in the region quickly and correct their paths in order to pass through as many updrafts as possible. We also carried out a simulation to show the benefits of the multi-agent approach in this task. Increasing the UAVs number to three increases the flight duration of each UAV more than twice.

II. PROBLEM STATEMENT

A. Soaring of One UAV

The airplane we modeled was based on a small unmanned powered glider. The objective of our vehicle is to conserve battery energy and soar as long as possible over the test area. In our experiments the UAV uses a very simple strategy. It flies along a predefined path, measuring the vertical airspeed using the readings of an onboard GPS module. Thermal updrafts are identified as areas with positive airspeed values. The UAV should locate thermal updrafts within its flight path and use them to gain altitude. After climbing to the maximum available altitude it should return to its course and use the energy obtained by switching to soaring mode, i.e. keep its engine off, gliding.

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РОССИЙСКАЯ ФЕДЕРАЦИЯ

СВИДЕТЕЛЬСТВО

о государственной регистрации программы для ЭВМ

№ 2010612684

SmartFly Together

Правообладатель(ли): ***Общество с ограниченной ответственностью «Смыслолёт» (RU)***

Автор(ы): ***Амелин Константин Сергеевич, Антал Екатерина Игоревна, Васильев Валентин Игоревич, Граничина Наталья Олеговна, Граничин Олег Николаевич (RU)***

Заявка № **2010611239**
Дата поступления **26 февраля 2010 г.**
Зарегистрировано в Реестре программ для ЭВМ
19 апреля 2010 г.

Руководитель Федеральной службы по интеллектуальной собственности, патентам и товарным знакам

Б.П. Симонов

SPRINT
SPbSU-Intel Laboratory

Project: Development of the master classes series of "Introduction to mobile application development on a Atom/MeeGo platform »

Principals – I.Odintsov, O.Granitchin, V.Kiyaev

Master classes on thematic schools in Nizhny Novgorod, St. Petersburg, Sarov, Chelyabinsk, Volgograd

Teachers:

I.Odintsov (Intel)

O.Granitchin (SPbSU)

V.Kiyaev (SPbSU)

K.Amelin (SPbSU)

A.Koryavko (SPbSU)

R.Lutchin (SPbSU)

E.Mel'nikova (SPbSU)

SPRINT
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Project: Development of the master classes series of "Introduction to mobile application development on a Atom/MeeGo platform »

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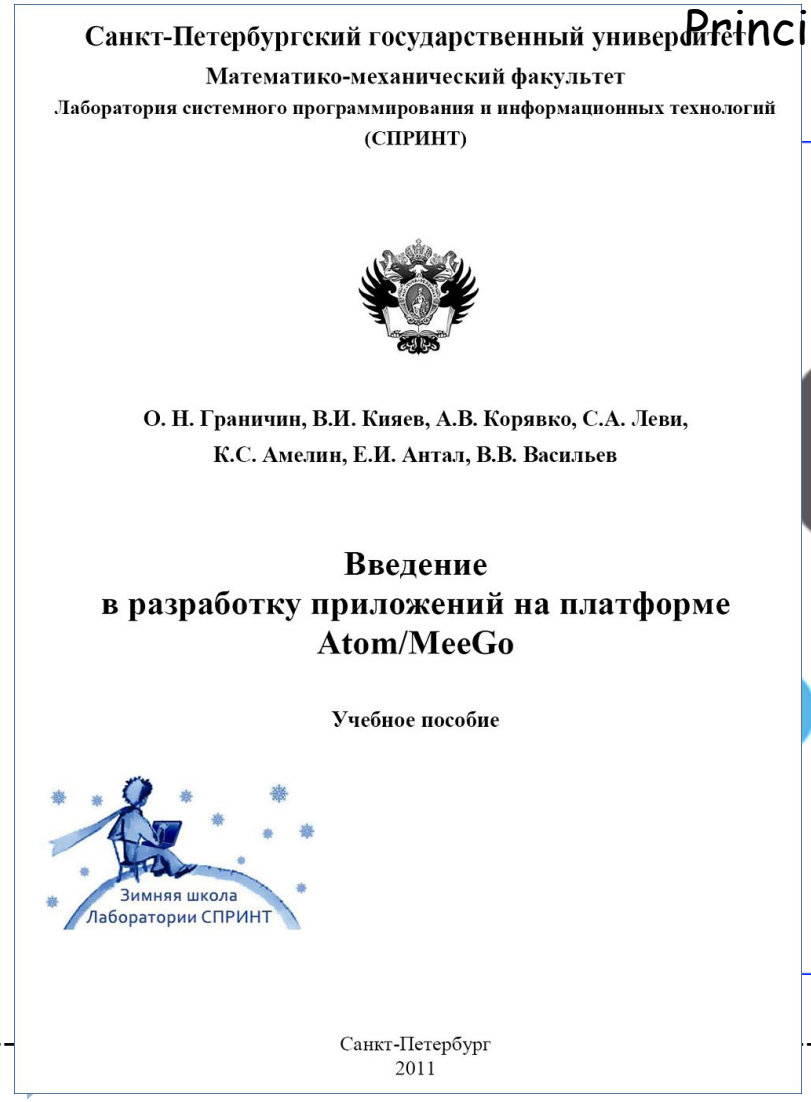

The course includes 16 lectures and 12 labs, consistently revealing the technology of application development on the MeeGo platform, the realization of quality and the product commercialization

SPRINT
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Our plans…

Together with Intel in every way to develop and expand MeeGo-ecosystem for students, graduate students and teachers!

Make it accessible to a wider audience textbook "Introduction to developing applications on the Atom / MeeGo platform» in Russian and English languages.

Develop a complete cycle of labs for applications programming on Atom / MeeGo

Take part in community MeeGo competitions

Develop projects for the development of control systems by ensembles of dynamic objects (unmanned aerial vehicles, robots, ...) on the basis of tablet PC with MeeGo

http//sprint-intel.phys.spbu.ru