

## Active Knowledge Engineering Laboratory



Nikolay N. Mirenkov  
Special Honorary Professor



Alexander P. Vazhenin  
Associate Professor



Rentaro Yoshioka  
Assistant Professor



Maxim Mozgovoy  
Assistant Professor



Malmivuo Jaakko  
Visiting Researcher



Marchuk Andrey  
Visiting Researcher

The Active Knowledge Engineering Lab activities include investigations that are about discovering, externalizing, expressing, representing, sharing, exploring, configuring, activating, growing and managing enterprise knowledge as well as designing new programming platforms based on mentioned above principles by focusing on the following topics.

1. Filmifications of Methods and Data Existing systems of symbols and notations are usually very abstract and there is a great gap between the form and meaning of data/knowledge. Our long-term education, in an essential part, is reduced to training our brain for being 'encoding-decoding' machine bridging this gap. The abstractness mentioned and bridging operations are sources of serious mental and physical problems for a great variety of people and, especially for disabled and elderly. Our aging society is also becoming information society. So, the above-mentioned aspect of our environment is becoming crucial. That is why, our research is to develop a new environment with lesser level of abstraction and with

the better quality of people life. Our general program is cyber-infrastructure including high-performance computing. We are also thinking about active knowledge being developed by humanity and undertaking research efforts in visual (multimedia) languages and tools, parallel and distributed systems. In a great part, our research and development are based on an idea of self-explanatory components in a cyberFilm format. A cyberFilm is a set of color stills supported, if necessary, by text, voice/sound and special links. Each still is to represent a view (some features) of objects or processes. Each cyberFilm is to represent a multiple view (an extended set of dynamic and/or static features) of objects or processes. The more accurate and relevant views are used, the greater adequacy is reached. The idea of cyberFilms is used for the specification of information resources and programming operations with the resources, as well as for the representation of multimedia messages and implementation of human-computer interfaces. The idea of equal opportunities to all individuals in the use of information resources is used to create a right set of cyberFilms and methods of their adaptation. We lead four clusters of projects related to filmification of methods and data: 1) Active Knowledge Studio for teachers, students, and programmers, 2) Semantic Surfaces in Ambient Living Environments for elderly, 3) Virtual objects, haptic interface and 3D printers for people doing fast prototyping, and 4) WWW-based software for users involved in multimedia programming and distance learning.

## 2. Human-Computer Interaction and Natural Language Parsing

Experimenting with human behavior via human-computer interaction is challenging and interesting topic with many possible problems. Our research interests include: - Artificial intelligence systems for computer games; - Virtual experiments based on human-computer interaction; - Understanding and modeling human behavior. Natural language processing is a challenging branch of modern artificial intelligence. Its applications include text analysis, machine translation, computer-assisted language learning, grammar checking, and information retrieval. Our current research is mostly focused at parsing, i.e. at analysis of language sentences in order to discover dependencies between individual words

## 3. Service-oriented Ubiquitous Environment for e-Learning and High-Performance Computing

The main goal of the project is in research and development of the multi-purposed Distributed Heterogeneous Environment that can easily be adapted to the different application areas. The system will allow integration of program and information components designed by different groups of developers. Accordingly, we are developed the virtual Model-View-Controller (MVC) design patterns in order to explore the other composite patterns for an efficient integration of the appli-

cations and services. Based on this platform, we are designing a set of application-oriented systems including Service-Oriented Tsunami Wave Propagation Modeling Tool and e-Learning Computational Cloud (eLC2). Main components of the Service-Oriented Architecture (SOA) for the Tsunami Wave Propagation Modeling are developing by adaptation of the MOST (Method of Splitting Tsunami) software package. A software tool developed allows implementing calculations remotely on the server by choosing the available computational resources via an ordinary WEB browser. The eLC2 is based on proposed a Task Management approach for e-Learning software components. We are exploring the strategy to collaborate components for automatic Task assignment, Problem generation and the Verification based on a Formula and Verification Engines that encapsulate the strategy. Wikipedia Miner re-usable services are an important part of this approach. We prototyped the WikiGloss tool which is based on a glossing approach helping learners of English-as-second-language on an extensive reading task. The other application is an Intelligent Hints service for a Task Management Environment by providing explanatory links from relevant Wikipedia articles related to topics of the e-Learning task.

Summary of Achievement

## Refereed Journal Papers

## Refereed Proceeding Papers

[mozgovoy-03:2012] M. Glukhikh E. Pyshkin, M. Mozgovoy. On Requirements for Acceptance Testing Automation Tools in Behavior Driven Software Development. In *Proceedings of the CEE-SECR 2012 Conference*, pages –, 2012.

-

[mozgovoy-04:2012] M. Mozgovoy D. Ninomiya. Improving POS Tagging for Ungrammatical Phrases. In *Proceedings of The Joint International Conference on Human-Centered Computer Environments*, pages 28–31, 2012.

-

[mozgovoy-05:2012] M. Mozgovoy. Towards WordBricks — a Virtual Language Lab for Computer-Assisted Language Learning. In *Proceedings of the 2nd International Workshop on Advances in Semantic Information Retrieval*, pages 251–254, 2012.

-

[mozgovoy-06:2012] M. Mozgovoy A. Zgonnikov, I. Lubashevsky. Dynamical Trap Effect in Virtual Stick Balancing. In *European Conference on Complex Systems*, pages –, 2012.

-

[mozgovoy-07:2012] M. Mozgovoy A. Zgonnikov, I. Lubashevsky. Computer Simulation of Stick Balancing. Action Point Analysis. In *Proceedings of The Joint International Conference on Human-Centered Computer Environments*, pages 162–164, 2012.

-

[rentaro-01:2012] Kazuhiro Wakisaka Atsushi Suzuki and Rentaro Yoshioka. A Method and Tool for Empirical and Practical Learning of Algorithms. In *Proceedings of 7th International Technology, Education and Development Conference (INTED 2013)*, pages 469–476. International Association of Technology, Education and Development, March 2013.

The tool based on a self-explanatory language that allows direct specification of activities and algorithmic features is proposed. Using this tool, a user can view, edit, and execute algorithms from a library and deepen their understanding by experimenting with parameters and formulas. This paper describes the unique usage of the language for algorithm learning and the features of the tool as well as results of an experiment to verify the learning effect.

- [vazhenin-05:2012] D. Vazhenin and A. Vazhenin. Implementation of Movie-based Matrix Algorithms on OpenMP Platform. In M. Paprzycki Editors M. Ganzha, L. Maciaszek, editor, *Federated Conference on Computer Science and Information Systems, FedCSIS 2011*, pages 491–494, Szczecin, Poland, September 2011. In cooperation with IEEE, Gesellschaft für Informatik Asociación de Técnicos de Informática, Naukowe Towarzystwo Informatyki Ekonomicznej, IEEE Conference Publications.

The convenience and programmer's productivity are the main point of visual programming systems and languages. From the other side, the parallel programming is mainly focused on reaching the high performance by optimization of executable code. The Movie-based Programming is based not only on the introduction of special symbols and images with semantic support, but also on a series of images that can present dynamical features of algorithms. The presented paper describes a technique of OpenMP parallelization of Movie-based algorithms in order to obtain the suitable program performance. The results of numerical experiments are also presented showing applicability of the proposed technique including implementation, code validity checking and performance testing.

- [vazhenin-06:2012] R. Cortez, A. Vazhenin, and K. Sato. Task Management Principles for e-Learning Environments. In K. Miura Editors A. Vazhenin, J. Herder, editor, *Proceedings of the Joint International Conference on Human-Centered Computer Environments (HCCE'12)*, pages 32–38, Aizuwakamatsu, Japan, March 2012. ACM, The International Conference Proceedings Series (ICPS) published by ACM.

This paper proposes the definition of a Task Management approach for e-Learning software components. The Task Management approach primary deals with subjects that require processing of mathematical expressions. We are exploring the strategy to collaborate components for automatic Task assignment with automatic Problem generation and the verification method. The support of the Task Management strategies in the framework of current systems, has

## Summary of Achievement

limitations handling automatic verification of mathematical expressions. Therefore, our proposal is to elaborate the strategy for an enhanced Task Management system based on a Formula and Verification Engines that encapsulate the strategy; moreover, that can be integrated within a distributed development platform and exposed under Business-to-Client mode of communication. We describe the components and strategy to follow in further implementation for numerical and formula based Task Management e-Learning systems.

[vazhenin-07:2012] A. Vazhenin, K. Hayashi, and A. Romanenko. Service-oriented tsunami wave propagation modeling tools. In K. Miura Editors A. Vazhenin, J. Herder, editor, *Proceedings of the Joint International Conference on Human-Centered Computer Environments (HCCE 2012)*, pages 131–136, Aizuwakamatsu, Japan, March 2012. ACM, The International Conference Proceedings Series (ICPS) published by ACM.

A big variety of methods and services for Tsunami Modeling require developing special approaches supporting integration of these heterogeneous components with respect to the various development platforms and architectures. In this paper, we are considering a way of transforming the Tsunami Wave Propagation Modeling Software to a Service-Oriented Architecture (SOA). The transformation was implemented based on the original Virtual MVC-design pattern (VMVC-pattern) that is demarcating a Functional (View) and an Implementation (Model) task by inducing an Integrator (Controller). The paper describes basic features of the MOST (Method of Splitting Tsunami) software package that was used as an initial Propagation Software Engine. It also includes an analysis the initial and output tsunami data and the description of a VMVC-based prototype in which control and resource management operations can be implemented via WEB-interface.

## Chapters in Book

[mozgovoy-08:2012] M. Mozgovoy T. Kakkonen. *Students' Cyber-Plagiarism. In: Encyclopedia of Cyber-Behavior*, pages 1168–1177. IGI Global, 2012.

## Grants

[rentaro-02:2012] R Yoshioka. Research and development of self-explanatory pro-

programming language for nuclear energy safety analysis , Japanese Nuclear Energy Safety, 2011-2012.

[vazhenin-08:2012] A. Vazhenin. Grant-in-Aid for Scientific Research: 21500948, Japanese Ministry of Education, Culture, Sports, Science and Technology, 2009-2011.

### **Academic Activities**

[vazhenin-09:2012] A. Vazhenin, 2011.

Reviewer of the International Journals: PARCO, Elsevier and the International Journal of Computers and Applications, ACTA Press

[vazhenin-10:2012] A. Vazhenin, March 2012.

Program Committee Member of the 26th IEEE International Conference on Advanced Information Networking and Applications (AINA-2012)

[vazhenin-11:2012] A. Vazhenin, September 2011.

Program Committee Member of the Federated Conference on Computer Science and Information Systems (FedCSIS2011)

[vazhenin-12:2012] A. Vazhenin, 2011.

Member of IEEE, ACM, IEICE, IPSJ

[vazhenin-13:2012] A. Vazhenin, 2012.

Program Committee Member of the 11th International Conference on New Trends in Software Methodologies, Tools and Techniques (SoMeT 2012)

[vazhenin-14:2012] A. Vazhenin, September 2012.

Program Committee Member of the Federated Conference on Computer Science and Information Systems (FedCSIS2012)

### **Ph.D and Others Theses**

[rentaro-03:2012] Atsushi Suzuki. A Method and Tool for Empirical and Practical Learning of Algorithms, University of Aizu, 2012.

Thesis Advisor: Yoshioka, R.

## Summary of Achievement

[rentaro-04:2012] Kazuhiro Wakisaka. A Method and Tool for Empirical and Practical Learning of Algorithms, University of Aizu, 2012.

Thesis Advisor: Yoshioka, R.

[rentaro-05:2012] Kohei Iwabuchi. Graduation Thesis: Code Rating Based on Programmatic Knowledge and Effort, University of Aizu, 2012.

Thesis Advisor: Yoshioka, R.

[rentaro-06:2012] Hiromasa Nagamine. Graduation Thesis: Method to Determine Algorithmic Similarities for Code Rating, University of Aizu, 2012.

Thesis Advisor: Yoshioka, R.

[rentaro-07:2012] Keiko Igarashi. Graduation Thesis: Basic Symbols and Rules for a Self-explanatory Machine Model, University of Aizu, 2012.

Thesis Advisor: Yoshioka, R.

[rentaro-08:2012] Saki Seino. Graduation Thesis: An Approach for PLC Program Generation from a Machine Model, University of Aizu, 2012.

Thesis Advisor: Yoshioka, R.

[rentaro-09:2012] Masatomo Kobi. Graduation Thesis: Simple Semantic Decoration Rules for 3D Kanji, University of Aizu, 2012.

Thesis Advisor: Yoshioka, R.

[vazhenin-15:2012] Hayato Tan. Service-oriented Movie-based Programming Environment, University of Aizu, 2012.

Thesis Advisor: A. Vazhenin

[vazhenin-16:2012] Ruth Patricia Cortez. Master Thesis: E-Learning Distributed Cloud Built on MVC Design Patterns for Service Task Management, University of Aizu, 2011.

Thesis Advisor: A. Vazhenin