

Onur Soysal

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University at Buffalo Ubiquitous Computing lab.
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Research Interests

Wireless Sensor Networks, Distributed Systems, Swarm Robotics, Adaptive Systems, Evolutionary Computation, Simulation

Education

- 2006-current** **University at Buffalo, SUNY**, Buffalo, NY
◊ *Ph.D. in Department of Computer Science and Engineering*, GPA=4/4
- 2005-2006** **Middle East Technical University**, Ankara, Turkey
◊ *Ph.D. student in Department of Computer Engineering*
- 2002-2005** **Middle East Technical University**, Ankara, Turkey
◊ *M.Sc. in Department of Computer Engineering*, GPA=3.5/4
Thesis Topic: "A Systematic Study of Probabilistic Aggregation Strategies in Swarm Robotic Systems"
Advisor: Asst. Prof. Dr. Erol Şahin
- 1998-2002** **Middle East Technical University**, Ankara, Turkey
◊ *B.Sc. in Computer Engineering*, GPA=3.42/4
◊ *Minor in Psychology*, GPA=3.43/4
- 1995-1998** **İzmir Science High School**, İzmir, Turkey, GPA=4.89/5

Academic Experience

University at Buffalo, SUNY, Buffalo, NY

Research Assistant

September, 2006 - present

- ◊ Deployed a 15 node WSN composed of Tmote Invent¹ and Tmote Sky motes in UbiComp lab, SUNY, Buffalo. Developed automation for programming, testing and data collection.
- ◊ Implemented TRANSACT, a programming framework for wireless sensor networks on Tmote Invent platform. TRANSACT framework provides reliable transaction-like semantics with serializability for WSNs. A TinyOS component that can be used for further application development is implemented².
- ◊ Implemented PollCast, a novel broadcast primitive for multi node coordination that utilizes collision information on the Tmote Invent platform. The CC2420 radio driver for TinyOS is modified to provide accurate collision detection required for this protocol. RSSI, clear channel assessment and CRC capabilities of CC2420 are combined in this work. A TinyOS component is provided for application developers.³
- ◊ Investigated use of mobile basestations to improve performance and lifetime of WSNs. Worked on theoretical analysis and simulations of the algorithms. Proposed algorithm uses a static WSN which maintains a dynamic binary tree. This tree is utilized to guide mobile base station

¹<http://www.moteiv.com>

²TRANSACT component can be downloaded from <http://ubicomp.cse.buffalo.edu/transact>

³PollCast component can be downloaded from <http://ubicomp.cse.buffalo.edu/pollcast>

toward data (similar to persuer evader scenario). Implemented a java simulator, to verify analytical results. ⁴

- ◇ Studied mobile sensor deployment algorithms with distributed and hierarchical control. Hierarchical control utilizes high level nodes that coordinate movement of other nodes and maintain an infrastructure for communication. In distributed control, a swarm algorithm is employed that only uses local information to provide comparable performance. Implemented, in collaboration with another student, a java based simulator for mobile data collection and mobile sensor deployment.⁵

My on going research focuses on investigation of Wireless Sensor Actuator Networks. Current projects include implementation of mobile base station algorithms on robot/WSN systems (composed of a Roomba⁶ and Tmote Invent nodes) and testbeds (Kansei⁷ test bed at Ohio State University).

Graduate Student

September, 2006 - current

Includes current Ph.D. research, coursework and projects.

- ◇ **Wireless Sensor Networks,** **CSE-646**
Link layer and MAC layer protocols, topology control, localization, routing querying and network reprogramming of wireless sensor networks. Implemented a transactional framework for wireless sensor networks programming on tinycos using nesC.
- ◇ Other course work include, algorithm analysis and design, computational geometry, networking, parallel and distributed processing.

Middle East Technical University, Ankara, Turkey

Research / Teaching Assistant

September, 2002 - 2006

- ◇ Worked in the KOVAN research lab. on biologically inspired robotics studies.
 - Developed a physics-based robot simulator using Open Dynamics Engine (ODE) with another student.
 - Developed Parallel Evolution System (PES), which is a software platform that parallelizes fitness evaluations of evolutionary methods over multiple computers connected via a network, with another student. Installed PES on a cluster of 128 computers at ULAKBİM high performance computing center. Conducted experiments on evolution of swarm robot controllers using this cluster.
 - Worked in the porting of physics-based Swarmbot3D robot simulator (developed in the Swarm-bots project) from a commercial physics engine (Vortex) to a free one (ODE). Previous expertise on ODE physics engine was utilized here. Also implemented a parser for XML world definition files with other students. This work was supported by sub-contract project for IRIDIA, Universite Libre de Bruxelles, within the Swarm-bots project.
 - Worked in design and implementation of MACSIM simulator, for MACS (Multi-sensory Autonomous Cognitive Systems Interacting with Dynamic Environments for Perceiving and Using Affordances) project. The simulator allows faithful simulation of Kurt2 mobile robot with 3 degrees of freedom crane arm, laser range scanner and stereo cameras. Rigid body dynamics are applied to this simulator using ODE. This project is supported by European Committee and KOVAN lab. is a partner in this project.
 - My master's thesis title is "A Systematic Study of Probabilistic Aggregation Strategies in Swarm Robotic Systems". It includes construction of probabilistic controllers for aggregation task and evaluation of their performances via systematic experiments. The simulation experiments involving rigid body dynamics were carried on the cluster of 128 computers at ULAKBİM high performance computing center. This work is partially supported by "Career Project: Controllable Robotic Swarms" awarded to Dr. Erol Şahin.

⁴Simulator called SalmonSim can be downloaded from <http://ubicomp.cse.buffalo.edu/salmonSim>

⁵Simulator called Omnitaxis can be downloaded from <http://ubicomp.cse.buffalo.edu/omnitaxis/>

⁶<http://www.irobot.com/>

⁷<http://ceti.cse.ohio-state.edu/kansei/>

- Gave a talk titled, “Swarm Robotics Related Research in KOVAN” in Swarm-Intelligence Systems Group in EPFL, Switzerland, with another student.
- ◊ Worked as teaching assistant in several courses
 - Senior Design Projects: Supervised and evaluated senior design projects. The supervising process included, weekly meetings with students, guidance, technical support and evaluations of designs and products. Supervised three of the four prize winner projects in the contest among senior design projects, in 2004-2005 semester.
 - Installed and maintained a 16-node PC cluster for parallel processing courses. Designed and evaluated undergraduate and graduate level assignments for these courses.
 - Designed and evaluated assignments in image processing, microprocessors, computer architecture & operating systems and autonomous robotics.
 - Worked as assistant representative, shared administrative responsibilities related with teaching assistants with faculty instructors.

Graduate Student

September, 2002 - 2006

Includes current M.Sc. research, Ph.D. and Masters level coursework and research projects.

- ◊ **Special topics in Fundamentals of Autonomous Robotics,** **CENG-710**
Reactive and hierarchical paradigms, subsumption architecture, sensors, actuators, robot navigation, vision, adaptation, and evolutionary methods in autonomous robotics. Projects involving indoor navigation and foraging were carried out on the Player/Stage simulator.
- ◊ **Neurocomputing,** **CENG-569**
Perceptrons, Backpropagation, Hopfield nets, Boltzmann machines, Kohonen nets, ART, Fuzzy ART, ARTMAP, modeling of biological neural circuits. Experiments were conducted to assess strong and weak aspects of certain types of artificial networks.
- ◊ **Optimization,** **EE-553**
Convexity, unconstrained & constrained minimization, steepest descent, Newton & quasi-Newton methods, and linear optimization.
- ◊ **Advanced Computer Graphics,** **CENG-538**
Illumination and rendering algorithms, their acceleration techniques and massively multi player online game (MMOG) architectures. The topics include: ray tracing, radiosity, parallel global illumination on multiprocessors, space subdivision, multi-resolution modeling, GPU programming and game development frameworks.
- ◊ **Evolutionary Computation,** **CENG-713**
Offers basic knowledge about the class of evolutionary methods used in solving engineering problems. This include genetic algorithms, evolutionary strategies, genetic programming, representations, genetic operations, theory of evolutionary algorithms.
- ◊ Other course work include, Statistical Data Analysis, Parallel Processing, Theory Of Computation, Image Processing, Pattern Recognition, and Artificial Intelligence.

Publications

S. Yoon, O. Soysal, M. Demirbas, C. Qiao *Coordinated Locomotion of Mobile Sensor Networks*. Fifth Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON), June 2008.

M. Demirbas, O. Soysal, and M. Hussain. *A Singlehop Collaborative Feedback Primitive for Wireless Sensor Networks*. INFOCOM miniconference, 2008.

M. Demirbas, O. Soysal, M. Hussain *TRANSACTION: A Transactional Framework for Programming Wireless Sensor/Actor Networks*. IPSN, 2008

M. Demirbas, O. Soysal, and A. S. Tosun (2007) *Data Salmon: A Greedy Mobile Basestation Protocol for Efficient Data Collection in Wireless Sensor Networks*. IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS),2007,Santa Fe, NM, USA.

O. Soysal, E. Bahçeci, and E. Şahin (2007), *Aggregation in Swarm Robotic Systems: Evolution and Probabilistic Control*. Turk. J. Elec. Engin., 15, (2007), 199-225.

O. Soysal, and E. Şahin (2007), *A Macroscopic Model for Self-organized Aggregation in Swarm Robotic Systems*, In Swarm Robotics: Second SAB 2006 International Workshop, Sahin E., Spears W., and Winfield A.F.T (editors), 4433, Lecture Notes in Computer Science, pages 27-42, Berlin Heidelberg, Springer.

O. Soysal, (2005) M.Sc. thesis: *A Systematic Study of Probabilistic Aggregation Strategies in Swarm Robotic Systems*

O. Soysal, Şahin E., (2005) *Probabilistic Aggregation Strategies in Swarm Robotic Systems*. In, Proc. of the IEEE Swarm Intelligence Symposium, 2005, Pasadena, California.

O. Soysal, E. Bahçeci, and E. Şahin (2003) *PES: A system for parallelized fitness evaluation of evolutionary methods*. In A. Yazici and C. Şener, editors, Proceedings of the Eighteenth International Symposium on Computer and Information Sciences (ISCIS), Lecture Notes in Computer Science 2869, pages 889-896, 2002. Springer-Verlag, Heidelberg, Germany.

E. Bahçeci, O. Soysal, E. Şahin (2003) *A Review: Pattern Formation and Adaptation in Multi-Robot Systems*. Technical Report CMU-RI-TR-03-43. Carnegie Mellon Univ, Pittsburgh, PA, USA.

Professional Experience

Los Alamos National Lab,
Research Intern

Los Alamos, NM
May 2008 - August 2008

Deployed a 15-node testbed using telos-b motes. Implemented automation and monitoring utilities for the testbed.

Developed a novel low power MAC layer for random routing protocols. Implemented this algorithm on telos-b motes and conducted performance and reliability tests.

Supervised work of two students on energy profiling of telos-b motes.

Microsoft SQL Server Performance Team,
Software Development Engineer Intern

Redmond, WA
May 2007 - August 2007

Worked as a performance engineer, engaged in performance testing, tracking and analysis.

Investigated effect of horizontal partitioning on TPC-H benchmark performance. Implemented automation for testing, gathered data, identified performance problems through analysis and reported the problems.

Implemented automation for performance tracking which aggregates various performance data and stores them in database for later analysis.

IntroSolutions,
Part-time C# , ASP.Net programmer

Ankara, Turkey
Aug 2002 - Nov 2003

Developed C# code for a web application on tourism that accesses SQL databases, Amadeus reservation web services. Also prepared ASP.Net web pages for this web application and admin interfaces.

PCK Electronics Limited,
Part-time Visual C++ programmer

Ankara, Turkey
Feb 2001 - Mar 2002

Developed C++ program for a medical imaging application to provide DICOM standard support, which includes implementation of storage and transfer algorithms.

Informatics Institute, METU,
Part-time Web designer, Java programmer

Ankara, TURKEY
Aug 2000 - Feb 2001

Designed web pages and developed Java applets demonstrating optimization algorithms for the Optimization course in Online Master Program.

**Artificial Neural Networks and Intelligent Systems
Laboratory, Dept. of Electrical and Electronics
Engineering, METU**

Ankara, TURKEY
Jul 2000 - Aug 2000

Summer Practice

Studied on classification of electroencephalogram (EEG) signals generated during sleep stages in human brain. The signals were taken from a group of test subjects, and main aim was detection of alpha brainwaves. Multi-layer perceptrons were trained using wavelet decomposition coefficients during this study.

Honors and Awards

- ◇ Ranked 1st in TÜBİTAK (The Scientific and Technical Research Council of Turkey) Research Project Competition Among High School Students, Informatics Branch, (Polynomial Operator Using Genetic Algorithms), 1997
- ◇ Won bronze medal in TÜBİTAK National Science Olympiads Among High School Students, Informatics Branch, 1997
- ◇ Ranked 2nd in TÜBİTAK Research Project Competition Among High School Students, Informatics Branch, (Behavior of Genetic Algorithms in Optimization of Multi-variable Functions), 1998
- ◇ Ranked 94th among approx. 1,200,000 students in ÖSS (Student Selection Examination) in Social Sciences Branch, 1998
- ◇ Ranked 87th among approx. 400,000 students in Science High School Selection Examination, 1995
- ◇ Ranked 63rd in among approx. 500,000 students in Anatolian High Schools Selection Examination, 1991

Computer Skills

- ◇ Languages: C, C++, NesC, Java, C#, ASP.Net, advanced Unix shell scripts, Matlab, Flash Action Script, Scheme, ML, lisp, prolog, SQL, HTML.
- ◇ Applications/Libraries: TinyOS, OpenGL, MFC, PVM, MPI, OpenMP, ODE (Open Dynamics Engine), galib, Player/Stage, Webots, L^AT_EX, common Windows database, spreadsheet, and presentation software.
- ◇ Operating Systems: Unix/Linux, Windows.
- ◇ GRE Computer Science Subject Test Score: 800

Languages

- ◇ Turkish: Native Speaker.
- ◇ English: Fluent (Toefl: 280 CBT)

Activities

- ◇ IEEE Computer Society METU Student Branch Chapter, Founder Member.
- ◇ METU Computer Club, Vice President
- ◇ TBD (Turkish IT Association) Youth Branch, Member
- ◇ METU Science Fiction & Fantasy Club, Member