Ivan Ruchkin

Researcher & educator in software/systems engineering
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Research Interests

Modeling, analysis, and verification of cyber-physical systems;

systems and software architecture; design and development toolchains.

Education

Carnegie Mellon University, School of Computer Science, Institute for Software Research.
Ph.D. student in Software Engineering. All But Dissertation.
08/2011 – present.
Dissertation: **Integration of Modeling Methods for Cyber-Physical Systems.**
Committee:
David Garlan (chair), André Platzer, Bruce Krogh, Dionisio de Niz, John Day.

Carnegie Mellon University, School of Computer Science, Institute for Software Research.
Master of Science in Software Engineering.
08/2011 – 12/2014.
GPA: 4.06/4.33.

Lomonosov Moscow State University, Faculty of Computational Mathematics and Cybernetics, Computing Systems Lab. Moscow, Russia.
Specialist degree (honors) in Applied Mathematics and Computer Science.
09/2006 – 06/2011.
GPA: 5.0/5.0.
Undergraduate thesis: **Tool View Interface for Integrated Development Environment**.

Research Projects

Architectural Approach to Integration of Cyber-Physical System Models
Role: lead author, contributor.
This project investigates supporting heterogeneous modeling and verification of cyber-physical systems using architectural abstractions. We model component-and-connector projections of CPS models to establish their consistency. I developed a logic-based language to specify consistency properties, and further enhanced the architectural approach in the context several systems, including a power-aware mobile robot.
2012 – present.

Model-Based Adaptation for Robotic Systems
Role: contributor.
In this project, we are creating an adaptive software layer to augment robots with robustness in the face of changing environment and limited resources. I have created models of power and software for TurtleBot mobile robots, and also developed an approach for correct integration of these models with the robot's adaptive control.
2015 – present.

Analysis Contracts Framework for Cyber-Physical Systems
Role: lead author.
The goal of this project is to provide a framework for integration of cyber-physical analyses based on their contracts. These contracts specify dependencies, assumptions, and guarantees of the analyses, and the framework verifies the contracts, thus making sure that the analyses are executed correctly. I have developed theory and tools behind this framework.
2013 – 2015.

End-User Architecting
Role: contributor.
This project developed support for end users in their creation of systems from components. As a case study, I created a formal model and a set of analyses for user compositions in Ozone Widget Framework – a visual analytics platform.
2011 – 2012.

Single-Window Integrated Development Environment
Role: lead author.
This project aimed to reduce cognitive burden of numerous tool views in integrated development environments. I designed, implemented, and evaluated a single-window IDE interface that replaces multiple tool views with more general and extensible UI mechanisms.
2008 – 2011.

Awards

Research

Frank Anger Memorial Award for crossover of ideas between the SIGSOFT and SIGBED communities. 05/2017.

Best Paper Award for paper **"**Challenges in Physical Modeling for Adaptation of Cyber-Physical Systems" at the Third IEEE World Forum on the Internet of Things. 12/2016.

Gold Medal in the ACM Student Research Competition at MODELS 2015 for paper "Architectural and Analytic Integration of Cyber-Physical System Models." Ottawa, Canada. 10/2015.

ACM SIGSOFT Distinguished Paper Award for paper "Architectural Abstractions for Hybrid Programs" at the 18th International Symposium on Component-Based Software Engineering, CompArch 2015. 05/2015.

Teaching

Special Recognition for Sustained Service in Teaching, School of Computer Science, Carnegie Mellon University. 04/2015.

Nominated for the **Graduate Student Teaching Award** (on two occasions), Carnegie Mellon University. 03/2014, 03/2015.

Misc

Heidelberg Laureate Forum Participant, selected among 200 young researchers worldwide to attend the Heidelberg Laureate Forum and meet recipients of top awards in mathematics and computer science (including the Turing Award). 09/2017.

First place in the Toastmasters Division 13D Table Topics (impromptu public speaking) contest. 10/2016.

Honors Degree (summa cum laude) in Applied Mathematics and Computer Science, Lomonosov Moscow State University. 06/2011.

Student Athlete Grant for active involvement and contributions to the athletic community of Lomonosov Moscow State University. 09/2009 – 05/2011.

Level III Physics Award in the Second Annual Lomonosov State School Olympiad. 04/2006.

Travel grants

NSF student travel award for the **ICSE** 2017 conference.

Carnegie Mellon Provost Conference travel funding for the **ICSE** 2017 conference. 05/2017.

Carnegie Mellon University's Graduate Student Assemly (GSA) *travel stipend* for the **MODELS** 2015 conference. 06/2015

ACM SIGSOFT *student travel award* for the Components and Architecture conference (**CompArch/WICSA**) 2015, ACM Special Interest Group on Software Engineering. 05/2015.

ACM SIGBED *student travel award* for the International Conference on Embedded Software (**EMSOFT**) 2014, ACM Special Interest Group on Embedded Systems. 10/2014.

Future of Software Engineering (**FuSE**) symposium *student travel grant*, University of Washington. 07/2013.

Publications

Journal

Ashutosh Pandey, Ivan Ruchkin, Bradley Schmerl, Javier Camara, David Garlan. **Formalizing the Hybrid Planning Problem for Self-Adaptation**. In submission to the ACM Transactions on Autonomous and Adaptive Systems (TAAS).

Journal

Akshay Rajhans, Ajinkya Bhave, Ivan Ruchkin, Bruce Krogh, David Garlan, Andre Platzer, Bradley Schmerl. **Supporting Heterogeneity in Cyber-Physical Systems Architectures**. The IEEE Transactions on Automatic Control (TAC), Vol. 59, issue 12, 2014.

Conference

Ivan Ruchkin, Joshua Sunshine, Grant Iraci, Bradley Schmerl, David Garlan, **IPL: An Integration Property Language for Multi-Model Cyber-Physical Systems**. In Proceedings of the 22nd International Symposium on Formal Methods (FM), Oxford, UK, 2018.

Conference

Ashutosh Pandey, Ivan Ruchkin, Bradley Schmerl, Javier Camara. **Towards a Formal Framework for Hybrid Planning in Self-Adaptation**. In Proceedings of the 12th International Symposium on Software Engineering for Adaptive and Self-Managing Systems (SEAMS). Buenos Aires, Argentina, 2017.

Conference

Ivan Ruchkin, Bradley Schmerl, David Garlan. **Architectural Abstractions for Hybrid Programs**. In Proceedings of the 18th International Symposium on Component-Based Software Engineering (CBSE), Montreal, Canada, 2015. **ACM SIGSOFT Distinguished Paper Award**.

Conference

Ivan Ruchkin, Dionisio De Niz, Sagar Chaki, David Garlan. **Contract-Based Integration of Cyber-Physical Analyses**. In Proceedings of the 14th International

	Conference on Embedded Software (EMSOFT), New Delhi, India, 2014.
Conference	David Garlan, Vishal Dwivedi, Ivan Ruchkin, Bradley Schmerl. **Foundations and Tools for End-User Architecting**, in 17th Monterey Workshop on Development, Operation and Management of Large-Scale Complex IT Systems, Oxford, UK, 2012.
Conference	Ivan Ruchkin, Vladimir Prus. **Single-Window Integrated Development Environment** in Spring/Summer Young Researchers' Colloquium on Software Engineering (SYRCoSE'10), Nizhny Novgorod, Russia, 2010.
Workshop	Ivan Ruchkin, Selva Samuel, Bradley Schmerl, Amanda Rico, David Garlan. **Challenges in Physical Modeling for Adaptation of Cyber-Physical Systems**. In the First Workshop on Models at Runtime & Networked Control for Cyber Physical Systems (MARTCPS) (in conjunction with WF-IoT). Reston, VA, 2016. **The IEEE World Forum on the Internet of Things Best Paper Award**.
Workshop	Ivan Ruchkin. **Integration Beyond Components and Models: Research Challenges and Directions**. In Proceedings of the 3th Architecture Centric Virtual Integration Workshop (ACVI) (in conjunction with WICSA/CompArch). Venice, Italy, 2016.
Workshop	Ivan Ruchkin, Ashwini Rao, Dionisio De Niz, Sagar Chaki, David Garlan. **Eliminating Inter-Domain Vulnerabilities in Cyber-Physical Systems: An Analysis Contracts Approach.** In the First ACM Workshop on Cyber-Physical Systems Security and Privacy (CPS-SPC) (in conjunction with CCS). Denver, CO, 2015.
Workshop	Ivan Ruchkin, Bradley Schmerl, David Garlan. **Analytic Dependency Loops in Architectural Models of Cyber-Physical Systems**. In the 8th International Workshop on Model-based Architecting of Cyber-Physical and Embedded Systems (ACES-MB) (in conjunction with MODELS). Ottawa, Canada, 2015.
Workshop	Ivan Ruchkin, Dionisio De Niz, Sagar Chaki, David Garlan. **ACTIVE: A Tool for Integrating Analysis Contracts**. In Proceedings of the 5th Analytic Virtual Integration of Cyber-Physical Systems (AVICPS) (in conjunction with RTSS) Workshop, Rome, Italy, 2014.
Other	Xiaokang Zhou, Guangquan Xu, Jianhua Ma, Ivan Ruchkin. **Scalable Platforms and Advanced Algorithms for IoT and Cyber-enabled Applications**. Editorial for the Elsevier Journal of Parallel and Distributed Computing (JPDC), Vol. 118, part 1, 2018.
Other	Tomas Bures, Danny Weyns, Bradley Schmerl, Eduardo Tovar, Eric Boden, Thomas Gabor, Ilias Gerostathopoulos, Pragya Gupta, Eunsuk Kang, Alessia Knauss, Pankesh Patel, Awais Rashid, Ivan Ruchkin, Roykrong Sukkerd, Christos Tsigkanos. **Software Engineering for Smart Cyber-Physical Systems: Challenges and Promising Solutions**. In the ACM SIGSOFT Software Engineering Notes (SEN), Vol. 42, Number 2, 2017.
Other	Xiaokang Zhou, Albert Zomaya, Weimin Li, Ivan Ruchkin. **Cybermatics: Advanced Strategy and Technology for Cyber-Enabled Systems and Applications**. Editorial for the Elsevier Future Generation Computer Systems (FGCS), Vol. 79, 2017.
Other	Amanda Rico, Ivan Ruchkin, Bradley Schmerl, David Garlan. **Hardware Power Modeling for TurtleBot**. Poster in the BRASS PI Meeting. Houston, TX, 2016.

Other	Ivan Ruchkin. **Architectural and Analytic Integration of Cyber-Physical System Models**. In the MODELS ACM Student Research Competition 2015. Ottawa, Canada. ACM SRC **Gold Medal Award**.
Other	Ivan Ruchkin. **Towards Integration of Modeling Methods for Cyber-Physical Systems**. In the MODELS Doctoral Symposium 2015. Ottawa, Canada.
Other	Ivan Ruchkin, Dionisio De Niz, Sagar Chaki, David Garlan. **Framework for Inter-Model Analysis of Cyber-Physical Systems**. Extended abstract and poster in 2nd Summer School on Cyber-Physical Systems, Grenoble, France, 2014.
Other	Ivan Ruchkin, Vishal Dwivedi, David Garlan, Bradley Schmerl. **Architectural Modeling of Ozone Widget Framework End-User Compositions**. Technical Report, Carnegie Mellon University, Pittsburgh, PA, 2014.
Other	Ivan Ruchkin, Stefan Mitsch, Akshay Rajhans, Jan-David Quesel, André Platzer, Bruce Krogh, David Garlan, Bradley Schmerl, Prashant Ramachandra, and Ken Butts. **An Architectural Approach to Heterogeneous Modeling and Verification of CPS**. Poster and extended abstract in the Fourth Annual Cyber-Physical Systems Principal Investigators Meeting, Arlington, VA, 2013.
Other	Ivan Ruchkin. **Interconnection of Heterogeneous CPS Models Through Architectural Views**. Extended abstract in the Third Annual Cyber-Physical Systems Principal Investigators Meeting, National Harbor, MD, 2012.

Teaching

Teaching education	**Future Faculty Program**, the Eberly Center for Teaching Excellence and Educational Innovation, Carnegie Mellon University. Fall 2012 – Spring 2017. 20+ seminars on evidence-based teaching methods, two teaching observations, two teaching projects, and a reading group.
Course teaching	**Guest instructor** in 15-313 **Foundations of Software Engineering**, Carnegie Mellon University. Fall 2014 and 2015. Design of the software architecture unit, guest lectures, preparation of a homework assignment and a recitation. **Guest instructor** in 17-651 **Models of Software Systems**, Carnegie Mellon University. Design of the Alloy course unit: guest lectures, homeworks, and recitations on the Alloy language. **Teaching assistant** and guest instructor in 17-655 **Architectures for Software Systems**, Carnegie Mellon University. Spring 2013 and 2014. Guest lectures and recitations, assignments redesign, grading, office hours. **Teaching assistant** in 15-214 **Principles of Software Construction**, Carnegie Mellon University. Fall 2012. Homework creation and grading, student-TA coordination, labs and recitations, office hours.

Mentoring

A **client** for a team of software engineering Masters students in a capstone project. Helping the students learn about requirements gathering, robotic frameworks, client interaction, and delivery/acceptance testing.

Mentor for:

- an undergraduate student (Summer 2017, now at University of Buffalo) who worked on implementing a language infrastructure for integration of models.
- one undergraduate (Summer 2016, now at Carthage College) and two graduate students (Summer 2016, now at Uber and Aquorn) who worked on power modeling, monitoring, navigation, and deployment for a personal robot.
- one graduate (Fall 2013, now at Rancher Labs) and one undergraduate (Fall 2014, now at eProseed) students who worked on architectural model generation with Alloy Analyzer.

Co-mentor for:

- an undergraduate student (Summer 2018, now at Grove City College) who worked on implementing hybrid planning for a drone swarm simulation.
- a graduate student (Fall 2016, now at Aquorn) who worked on robot actuation and runtime architecture discovery.

Industrial Experience

Software Engineering Institute, High-Confidence Cyber-Physical Systems group. Pittsburgh, PA. 05/2013 – 08/2013.
Position: research intern.
Designed the analysis contracts framework for integration of analytic procedures in cyber-physical systems.

NASA Jet Propulsion Laboratory, Multimission Ground System and Services Office (MGSS). Los Angeles, CA. 05/2012 – 07/2012.
Position: intern.
Analyzed the gap analysis between current software reuse process at MGSS and software product line practices. Proposed a plan for requirements, designs, and test cases to improve reuse over multiple projects.

Si-Trans Ltd., an international transport and logistics company**.** Moscow, Russia.
Position: part-time software developer, UI designer. 04/2010 – 04/2011.
Supported an existing ERM system, elicited requirements and prototyped a UI for a new ERM system, made improvements in the development process.

Google Summer of Code program with Google and Thousand Parsec. 05/2010 – 08/2010.
Position: remote software developer, Google Summer Of Code participant.
Redesigned and developed a UI for a cross-platform client for Thousand Parsec – a 2D strategy videogame.

Computing Systems Lab, Lomonosov Moscow State University. Moscow, Russia. 09/2008 – 05/2010.
Position: part-time software developer, UI designer, and analyst in a R&D project.
Developed an OS-level client security application, designed and developed a dashboard for network security analytics.

Service

Conference organization	**Student volunteer** at the following conferences: • ICSE (Buenos Aires, Argentina, 05/2017) • CPS Week (Pittsburgh, PA, 04/2017) • SPLASH (Pittsburgh, PA, 10/2015) • MODELS 2015 conference (Ottawa, Canada, 09/2015)
University	Member of the Software Engineering **PhD student admission committee**, Institute for Software Research, Carnegie Mellon University, Pittsburgh, PA. 01/2016. Member of the Office of International Education's **foreign student advisory committee**, Carnegie Mellon University. 08/2014 – present. Interviews with job candidates, advising on international student policy, representation in the CMU board meeting, outreach, organization of the foreign student orientation. Member of the 2013 and 2014 **admission committee** for a joint Innopolis-Carnegie Mellon University Masters in Information Technology – Software Engineering program. 03/2014, 03/2013. Evaluation of applications, interviews with candidates. Member of the Software Engineering PhD program **curriculum committee**, Institute for Software Research, Carnegie Mellon University. 12/2012. Representation of PhD student interests, review of changes to the PhD program requirements.
Paper Reviewing	**Journal reviewer** Concurrency and Computation: Practice and Experience (CCPE) 2018, Annual Reviews in Control (ARC) 2017, Empirical Software Engineering (EMSE) 2017, IEEE Software 2017, Simulation Modeling Practice and Theory (SIMPAT) 2017, Science of Computer Programming (SCP) 2016 & 2017, Future Generation Computer Systems (FGCS) 2017. **Program committee** Intl. Workshop on Robotics Software Engineering (RoSE) 2018. **Subreviewer** Conferences: ICSA 2018, SEAMS 2018, SASO 2017, WICSA/CompArch 2016, APSEC 2016, WF-IoT 2016, ICSE 2015, ECSA 2015, ECSA 2014, ICSE 2012, WICSA 2012. Journals: Design & Test 2015, Transactions on Software Engineering and Methodology (TOSEM) 2012.
Miscellaneous	**Co-chair** of Dec/5 – Carnegie Mellon's CS graduate student organization. 08/2013 – 05/2014. Networking events organization with tech companies: fundraising and operations. **Webmaster** for the Pittsburgh Pharaoh Hounds – a competitive long-distance running club. 05/2014 – present. Web design and maintenance, representation and outreach. **Captain** of the department's track and field team, Lomonosov Moscow State University. 09/2008 – 05/2011. Planning, outreach, and team organization.

Technical Skills

Software engineering	• Requirements elicitation, architectural design and evaluation, object-oriented analysis and design with UML, object-oriented design patterns. • Collaborative development: issue tracking systems Trac, Redmine, and Mantis, version control with Git, Subversion, and Mercurial. • Modeling and verification: formal specification languages (Z, Alloy, JML), formal logic, model checking and SMT solving (Promela/Spin, Z3), theorem proving (KeYmaera, PVS).
Human-Computer Interaction	• Contextual inquiry, user interface design, usability evaluation and testing, cognitive modeling. • User interface implementation with Qt, Swing/AWT, SWT, wxWidgets, Windows UI API.
Languages and technologies	• Java (J2SE), C/C++ (STL, Boost, Windows API, VCL, CLX, POSIX API, OpenGL). • Python, Ruby, Windows Shell, Bash. • MySQL, PostgreSQL, T-SQL. • Eclipse platform: OSGi, RCP, EMF, XText. • Robotic Operating System (ROS). • Lisp, Prolog. • Intel x86 assembly language (basic). • HTML, CSS, XML, XPath, XSLT.

Miscellaneous

Languages	English – fluent, Russian – native, French – basic.
Memberships	ACM Student Member (SIGSOFT, SIGBED), IEEE Student Member, CPS-VO Member.
Certificates & Examinations	• Mental Health First Aid training, 7/2017. • Old Student in the S.N. Goenka Vipassana tradition (10-day course), 12/2016. • English for Academic Purposes Certificate, ELS, Point Park University, 08/2011. • Certified English-Russian Translator in Applied Mathematics and Informatics. Lomonosov Moscow State University, 2010.

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