

Renato Mancuso | CV

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Education

- **Ph.D. in Computer Science** **Urbana, IL, USA**
University of Illinois at Urbana-Champaign *2012-2017*
Dissertation title: "Next-generation Safety-critical Systems on Multi-Core COTS Platforms"
Thesis advisor: Professor Marco Caccamo
- **M.Sc. in Computer Engineering** **Rome, Italy**
University of Rome Tor Vergata, Magna cum laude *2009-2012*
Thesis title: "Avoiding Memory Access Conflicts in Hard Real-time Multi-core Systems"
Advisor: Professor Marco Cesati
- **B.Sc. in Computer Engineering** **Rome, Italy**
University of Rome Tor Vergata, Magna cum laude *2006-2009*
Thesis title: "CoreBoot: the Open-source BIOS and Bootloader"
Advisor: Professor Daniel P. Bovet

Research Interests

Investigating, implementing and testing novel **OS designs** and corresponding **scheduling frameworks** to create robust, predictable and high-performance platforms for **safety-critical cyber-physical systems (CPS)**, with special focus on automotive, avionics and unmanned aerial vehicles.

Research Experience

- **Graduate Research Assistant** **Urbana, IL, USA**
Department of Computer Science, UIUC *2012-2014*
Supported by: Rockwell Collins Inc. and NSF
 - Evaluation of real-time predictability and performance degradation due to inter-core performance interference on shared memory hierarchy
 - Design and feasibility study of techniques to mitigate performance interference in shared CPU caches
 - OS-level implementation of proof-of-concept support for real-time oriented shared cache management
- **Graduate Research Assistant** **Urbana, IL, USA**
Department of Computer Science, UIUC *2014-2015*
Supported by: Rockwell Collins Inc. and NSF
In collaboration with: Department of Aerospace Engineering, UIUC
 - Study of techniques to reduce performance interference due to DRAM bank sharing
 - OS-level implementation of proof-of-concept support for real-time oriented DRAM bank management
 - Integration of hardware resource management techniques for overall evaluation and theoretical scheduling
 - Design of OS-level techniques for power adaptive CPU+GPU UAVs.
 - Construction of a UAV testbed for live evaluation
- **Graduate Research Assistant** **Urbana, IL, USA**
Department of Computer Science, UIUC *2015-Present*

Supported by: Hitachi America Ltd. and NSF

- Predictability evaluation of new-generation multi-core automotive platforms for ASIL-D certification
- Re-design of OS-level resource management and scheduling to exploit heterogeneous memory layout
- Design of OS-level predictable strategies to recover from detectable memory errors
- Proof-of-concept implementation extending an existing AUTOSAR-compliant OS

Teaching and Mentoring Experience

- **Teaching Assistant, System Programming (CS-241)** **Urbana, IL**
Spring 2013
College of Engineering, University of Illinois
 - Prepared discussion sections with presentations and interactive programming sessions with 60 students
 - Held office hours with live debugging of student code and clarification of class material
 - Prepared machine problems, instructions for assignments and grading strategies
 - Implemented, maintained and executed auto-graders
 - Graded assignments (with auto-graders), midterms and finals
 - Coordinated with other TAs and faculty for the direction of the course
- **Undergraduate Mentor** *2013 - Present*
Department of Computer Science, University of Illinois
 - Evaluated student fit to research projects based on CV evaluation and interviews
 - Assigned students to ongoing research projects based on their inclinations
 - Drafted project statement to be used as written agreement for independent study projects (CS-397)
 - Prepared embedded platforms, source trees, development environments and repositories for students
 - Evaluated/interviewed 11 students; mentored 5 students
- **Graduate Mentor** *2014 - Present*
Department of Computer Science, University of Illinois
 - Coordinated with faculty over student selection for Ph.D. program or short-term visiting
 - Assessed student fit to research group based on CV and research interests
 - Suggested short-term and long-term research path
 - Guided new students to understand the exact scope of project, write formal reports and prepare presentations for conferences and industry partners
 - Prepared literature review list for incoming students and introduced basic background concepts
 - Mentored 3 students
- **Invited Lecturer, Cyber-Physical Systems** **Munich, Germany**
Jan. 2015
Dept. of Electrical and Computer Engineering, Technical University of Munich
 - Prepared and lectured 4 graduate-level classes on Network Calculus and Real-Time Calculus
 - Integrated lectures with rest of course material
 - Prepared questions about presented material for practice exam and final exam
- **Invited Lecturer, System Programming (CS-241)** **Urbana, IL**
Feb. 2014
College of Engineering, University of Illinois
 - Prepared tool to demonstrate virtual memory mapping and manipulate memory of running processes
 - Lectured about theory on memory mapping
 - Performed live demonstration of attacks on memory of running processes

Honors and Awards

- **Best Presentation Award**
IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS) *Apr. 2016*
- **Best Paper Award**
IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS) *Apr. 2013*

- **Finalist, Qualcomm Innovation Fellowship** *Spring 2016*
 Qualcomm Inc.
 The QInF program is focused on recognizing, rewarding, and mentoring innovative PhD students across a broad range of technical research areas, based on Qualcomm's core values of innovation, execution and teamwork.
- **Computer Science Excellence Fellowship** *Fall 2015, Spring 2016*
 College of Engineering, University of Illinois
 The Computer Science Excellence Fellowship is funded thanks to the Graduate College's Block Grant Program, which provides funds to help departments recruit and retain outstanding graduate students.
- **Provisional Patent** **Urbana, IL, USA**
August 2016
 University of Illinois at Urbana-Champaign
 Title: "Real-Time Scratchpad-Centric Operating System for Multi-Core Embedded System"
- **Recognized on List of Teachers Ranked Excellent** *Fall 2013*
 College of Engineering, University of Illinois
- **Homo Sapiens Sapiens Scholarship** *Spring 2014*
 INPS Italy
 Government-issued scholarship to support high-degree education in promising young researchers
- **Patent, Main Inventor** **Rome, Italy**
May 2014
 CFI Progetti LLC.
 Title: "Providing Interactive Pharmaceutical Services through Internet"
 Submitted/accepted: June 2011 / May 2014
 Patent Nr.: RM2011A000297
- **Merit Scholarship** *Spring 2010*
 Accenture, PLC
- **High Honor Award and Scholarship** **Rome, Italy**
2009, 2010, 2011, 2012
 University of Rome Tor Vergata
- **Full Merit Scholarship** **Rome, Italy**
2006-2011
 Excellence University College "Lamaro-Pozzani"
 Awarded by the Italian Federation "Cavalieri del Lavoro" on a merit-only basis, through a competitive selection procedure involving students from all over Italy. The scholarship was renewed every year, having reached fixed targets, such as: passing all the scheduled university exams with an average grade of at least 27/30, succeeding in the English, Economics and Law internal courses and actively attending all the College activities, meetings and lectures.

Peer Reviewed Conference and Journal Papers

Published.....

- [1] A. Melani, **R. Mancuso**, M. Caccamo, G. Buttazzo, J. Freitag, S. Uhrig, "A Scheduling Framework for Handling Integrated Modular Avionic Systems on Multicore Platforms", In Proceedings of the 23rd IEEE International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA). Hsinchu, Taiwan. To Appear.
- [2] F. Abdi, **R. Mancuso**, R. Tabish, M. Caccamo, "Restart-Based Fault-Tolerance: System Design and Schedulability Analysis", In Proceedings of the 23rd IEEE International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA). Hsinchu, Taiwan. To Appear.
- [3] **R. Mancuso**, R. Pellizzoni, N. Tokcan, M. Caccamo, "WCET Derivation under Single Core Equivalence with Explicit Memory Budget Assignment", Proceedings of the 29th Euromicro Conference on Real-Time Systems (ECRTS), June 2017, Dubrovnik, Croatia. To appear.
- [4] **R. Mancuso**, R. Dudko, E. Betti, M. Cesati, M. Caccamo, R. Pellizzoni, "Real-Time Cache Management Framework for Multi-core Architectures", Proceedings of the IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS), April 2013, Philadelphia, USA. **(Best Student Paper Award)**

- [5] **R. Mancuso**, R. Pellizzoni, M. Caccamo, L. Sha, H. Yun, "WCET(m) Estimation in Multi-Core Systems using Single Core Equivalence", Proceedings of the 27th Euromicro Conference on Real-Time Systems (ECRTS), July 2015, Lund, Sweden.
- [6] **R. Mancuso**, A. V. Louis, M. Caccamo, "Using Traffic Phase Shifting to Improve AFDX Link Utilization", Proceedings of the 15th ACM International Conference on Embedded and Software (EMSOFT). Amsterdam, The Netherlands, October 2015.
- [7] L. Sha, M. Caccamo, **R. Mancuso**, J. E. Kim, M. K. Yoon, R. Pellizzoni, H. Yun, R. B. Kegley, D. R. Perlman, G. Arundale, R. Bradford, "Real-Time Computing on Multicore Processors", IEEE Computer, vol. 49 no. 9, p. 69-77, September 2016.
- [8] A. Melani, **R. Mancuso**, D. Cullina, M. Caccamo, L. Thiele, "Optimizing Resource Speed for Two-Stage Real-Time Tasks", Real-Time Systems, doi:10.1007/s11241-016-9259-y, September 2016.
- [9] F. Abdi, **R. Mancuso**, S. Bak, O. Dantsker, M. Caccamo, "Reset-Based Recovery for Real-Time Cyber-Physical Systems with Temporal Safety Constraints", Proceedings of the 21st IEEE International Conference on Emerging Technologies Factory Automation and Applications Symposium (ETFAs), Berlin, Germany, September 2016.
- [10] R. Tabish, **R. Mancuso**, S. Wasly, A. Alhammad, S. S. Phatak, R. Pellizzoni, M. Caccamo, "A Real-Time Scratchpad-centric OS for Multi-core Embedded Systems", Proceedings of the IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS), April 2016, Vienna, Austria. (**Best Presentation Award**)
- [11] R. Tabish, **R. Mancuso**, S. Wasly, S. S. Phatak, R. Pellizzoni, M. Caccamo, "A Reliable and Predictable OS for Real-Time Embedded Systems", Proceedings of the IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS), Pittsburgh, USA, 2017. To Appear.
- [12] M. Cesati, **R. Mancuso**, E. Betti, M. Caccamo, "A Memory Access Detection Methodology for Accurate Workload Characterization", Proceedings of the IEEE International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA). Hong Kong, China, August 2015.
- [13] A. Melani, **R. Mancuso**, D. Cullina, M. Caccamo, L. Thiele, "Speed Optimization for Tasks with Two Resources", Proceedings of the International Conference on Design, Automation, and Test in Europe (DATE). Dresden, Germany, March 2016.
- [14] **R. Mancuso**, Or D. Dantsker, M. Caccamo, M. S. Selig, "A Low-Power Architecture for High Frequency Sensor Acquisition in Many-DOF UAVs", Proceedings of the 5th Intl. Conference on Cyber-Physical Systems (ICCPs), April 2014, Berlin, Germany.
- [15] H. Yun, **R. Mancuso**, Z. Wu, R. Pellizzoni, "PALLOC: DRAM Bank-Aware Memory Allocator for Performance Isolation on Multicore Platforms", Proceedings of the IEEE Intl. Real-Time and Embedded Technology and Applications Symposium (RTAS), April 2014, Berlin, Germany.
- [16] G. Gracioli, A. Alhammad, **R. Mancuso**, A. A. Frohlich, R. Pellizzoni, "A Survey on Cache Management Mechanisms for Predictable Real-Time Embedded Systems", Accepted for publication on ACM Computing Survey, September 2015.
- [17] **R. Mancuso**, P. Srivastava, D. Cheng, M. Caccamo, "A Hardware Architecture to Deploy Complex Multiprocessor Scheduling Algorithms", Proceedings of the IEEE International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA). Chongqing, China, August 2014.
- [18] **R. Mancuso**, R. Dudko, M. Caccamo, "Light-PREM: Automated Software Refactoring for Predictable Execution on COTS Embedded Systems", Proceedings of the IEEE International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA). Chongqing, China, August 2014.
- [19] Or D. Dantsker, **R. Mancuso**, M. S. Selig, M. Caccamo, "High-Frequency Sensor Data Acquisition System (SDAC) for Flight Control And Aerodynamic Data Collection Research on Small to Mid-Sized UAVs", Proceedings of the AIAA Aviation and Aeronautics Forum and Exposition, Applied Aerodynamic Conference, (APA'14). Atlanta, Georgia, June 2014.
- [20] Y. Gao, S. Hu, **R. Mancuso**, M. Kim, P. L. Wu, L. Su, L. Sha, T. Abdelzaher, "Exploiting Structured Human Interactions to Enhance Estimation Accuracy in Cyber-physical Systems", Proceedings of the IEEE International Conference on Cyber-Physical Systems (ICCPs 2015), Seattle, WA, USA.
- [21] F. Abdi, J. V. D. Woude, Y. Lu, S. Bak, M. Caccamo, L. Sha, **R. Mancuso**, S. Mohan, "On-Chip Control Flow Integrity Check for Real Time Embedded Systems", Proceedings of the 1st IEEE Intl. Conference on

Cyber-Physical Systems, Networks and Applications (CPSNA), August 2013, Taipei, Taiwan.

Technical Reports.....

- [1] A. Melani, **R. Mancuso**, D. Cullina, M. Caccamo, L. Thiele, "Resource Speed Optimization for Two-Stage Flow-Shop Scheduling", Technical Report at UIUC, Available at: <http://hdl.handle.net/2142/88404>
- [2] **R. Mancuso**, R. Pellizzoni, M. Caccamo, L. Sha, H. Yun, "Response-Time Analysis for Single Core Equivalence Framework", Technical Report at UIUC, Available at: <http://hdl.handle.net/2142/55570>
- [3] L. Sha, M. Caccamo, **R. Mancuso**, J.E. Kim, M.K. Yoon, R. Pellizzoni, H. Yun, R. Kegley, D. Perlman, G. Arundale, R. Bradford, "Single Core Equivalent Virtual Machines for Hard Real-Time Computing on Multicore Processors", Technical Report at UIUC, Available at: <http://hdl.handle.net/2142/55672>
- [4] M. Cesati, **R. Mancuso**, E. Betti, M. Caccamo, "MadT: A Memory Access Detection Tool for Symbolic Memory Profiling", Technical Report at UIUC, Available at: <http://hdl.handle.net/2142/78093>
- [5] **R. Mancuso**, A. V. Louis, M. Caccamo, "Improving Bandwidth Utilization With Deterministic Delivery Guarantees in AFDX through Traffic Phase-Shifting", Technical Report at UIUC, Available at: <http://hdl.handle.net/2142/78193>

Presentations and Talks

Conference Presentations.....

1. **"A Real-Time Scratchpad-centric OS for Multi-core Embedded Systems"** **Vienna, Austria**
Apr. 2016
IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS)
2. **"Real-Time Cache Management Framework for Multi-core Architectures"** **Philadelphia, PA, USA**
Apr. 2013
IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS)
3. **"WCET(m) Estimation in Multi-Core Systems using Single Core Equivalence"** **Lund, Sweden**
July 2015
Euromicro Conference on Real-Time Systems (ECRTS)
4. **"Using Traffic Phase Shifting to Improve AFDX Link Utilization"** **Amsterdam, Netherlands**
Oct. 2015
ACM International Conference on Embedded and Software (EMSOFT)
5. **"Reset-Based Recovery for Real-Time Cyber-Physical Systems"** **Berlin, Germany**
Sept. 2016
IEEE Emerging Technologies Factory Automation and Appl. Symposium (ETFSA)
6. **"A Memory Access Detection Methodology for Accurate Workload Characterization"** **Hong Kong, China**
Aug. 2015
IEEE Int. Conference on Embedded and Real-Time Systems and Applications (RTCSA)
7. **"A Low-Power Architecture for High Frequency Sensor Acquisition in Many-DOF UAVs"** **Berlin, Germany**
Apr. 2014
IEEE Int. Conference on Cyber-Physical Systems (ICCP)
8. **"A Hardware Architecture to Deploy Complex Multiprocessor Scheduling Algorithms"** **Chongqing, China**
Aug. 2014
IEEE Int. Conference on Embedded and Real-Time Systems and Applications (RTCSA)
9. **"Light-PREM: Software Refactoring for Predictable Execution on Embedded Systems"** **Chongqing, China**
Aug. 2014
IEEE Int. Conference on Embedded and Real-Time Systems and Applications (RTCSA)
10. **"On-Chip Control Flow Integrity Check for Real Time Embedded Systems"** **Taipei, Taiwan**
Aug. 2013
IEEE Intl. Conference on Cyber-Physical Systems, Networks and Applications (CPSNA)

Other Talks.....

1. **"Hypervisor-level System Protection with SafeVisor"** **San Diego, CA, USA**
May. 2016
Qualcomm Inc. - Qualcomm Innovation Fellowship
2. **"Toward certifiable avionics platforms: Single Core Equivalent (SCE) - Part 1"** **Seattle, WA, USA**
Apr. 2015
First TCRTS Workshop on Certifiable Multicore Avionics Systems (CMAS)
3. **"Scratchpad-centric Resource Management"** **Farmington Hills, MI, USA**
May. 2015
Hitachi Automotive Ltd. - Technology Transition Workshop
4. **"Single-Core Equivalence (SCE) Tutorial"** **Berlin, Germany**
Apr. 2014
Cyber-Physical Systems Week (CPSWeek)

5. **“Workshop on Multi-Core Performance Isolation using Freescale P4080”** **Denver, CO, USA**
Lockheed Martin - Technology Transition Workshop *Jan. 2013*
6. **“A Hands-on Tutorial on Performance Isolation Techniques”** **Urbana, IL, USA**
Lockheed Martin - Technology Transition Workshop *Apr. 2013*
7. **“Automatic Predictability-Oriented Refactoring of Application Code”** **Philadelphia, PA, USA**
WIP – IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS) *Apr. 2013*

Services to the Community

Program Committee Member.....

- *10th Junior Researcher Workshop on Real-Time Computing (JRWRTC)* *Sept. 2016*

Co-organizer.....

- **Co-organizer for TCRTS CPSWeek Tutorial** **Pittsburgh, PA, USA**
2nd TCRTS Workshop on Certifiable Multicore Avionics and Automotive Systems (CMAAS) *2017*
- **Co-organizer for ACM/IEEE CPSWeek Tutorial** **Berlin, Germany**
Single Core Equivalent (SCE) Architecture Framework for Safety-critical Multi-core Systems *2014*

Session Co-chair.....

- **ACM International Conference on Embedded Software (EMSOFT)** **Amsterdam, The Netherlands**
Session 6 - Energy Efficiency and Security *2015*

Primary Reviewer.....

- *IEEE Transactions on Computers (TC) – twice* *2017*
- *Springer Real-Time Systems Journal (RTSJ) – twice* *2016*
- *ACM Transactions on Cyber-Physical Systems (TCPS)* *2016*
- *ACM Transactions on Embedded Computing Systems (TECS)* *2017*

Secondary Reviewer.....

- *Springer Real-Time Systems Journal (RTSJ)* *2016*
- *ACM Transactions on Embedded Computing Systems (TECS)* *2014*
- *IEEE Transactions on Industrial Informatics (TII)* *2013*
- *ACM/IEEE Symposium on Embedded Systems For Real-Time Multimedia (ESTIMedia)* *2012, 2013, 2014*
- *IEEE International Conference on Cyber-Physical Systems (ICCPs)* *2013, 2015, 2016, 2017*
- *ACM Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES)* *2015*
- *IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS)* *2013, 2014, 2016*
- *IEEE Real-Time Systems Symposium (RTSS)* *2014, 2015*
- *IEEE International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA)* *2016, 2017*
- *Euromicro Conference on Real-Time Systems (ECRTS)* *2014*
- *Design Automation Conference (DAC)* *2017*
- *IEEE Emerging Technologies Factory Automation and Applications Symposium (ETFA)* *2017*

Professional Experience

- **Co-founder** **Urbana, IL**
AlVolo LLC. *2016-Present*
 - Development of fully integrated data acquisition and sensor fusion system for UAVs
 - Performed custom PCB, firmware and OS development
 - Developed browser-based configuration interface to simplify in-the-field deployment
 - More info available at: <http://www.alvolo.us>
- **Ph.D. Intern** **Pisa, Italy**
Evidence Inc. *June-Aug. 2014*

- Porting of RTOS to new-generation multi-core micro-controller (Freescale MPC5777M)
- Augmented RTOS to support DMA-assisted task loading and scheduling
- Evaluation of achievable performance and timing properties of augmented RTOS

- **Co-founder and CIO**

Rome, Italy
2012-2013

- *ShowOn LLC.*

- Ground-up development of a vertical social networking platform with LAMP platform
- System administration, development team recruitment, task assignment and progress assessment
- Data analysis of the highly segmented user base – about 30000 users
- Design of interaction with existing services via APIs to centralize content management

Technical skills

- **Programming/Scripting:** C, C++, ASM (IA32, AMD64, PowerPC, ARM), Java, Bash, Python, Makefile
- **Experienced in Linux Kernel development,** ARM-based and PowerPC-based platforms, Xilinx Zynq-7000, Microchip PIC18/32, Freescale MPC56xx and MPC57xx, Arduino, ArduPilot, TI MSP
- **Hardware Debugging:** Lauterbach PowerDebug & PowerTrace, GreenHills SuperTrace Probe
- **Hardware Design:** Verilog, VHDL
- **Web Development:** PHP, SQL, JavaScript, Node.js, Handlebars

Language Skills

Italian: Native speaker

English: Fluent

Turkish: Intermediate

References

References available upon request.