



# CYBER-PHYSICAL SYSTEMS

## DESCRIPTION

This research area aims at achieving the 3C convergence, i.e., the deep integration of computing, control and communication for the design of modern complex systems, which include cyber-physical, real-time, embedded, hardware and software subsystems, with applications ranging from robotics to automotive, avionics, energy, biology. The core research on computing aspects is related to modeling, verification and optimization of intelligent cyberphysical systems, with particular emphasis on models of computation, manipulation of description languages, semi-formal and formal verification, hardware and software automated synthesis and compilation, correct-by-construction refinement and optimization, fundamental CAD algorithms, development of power-aware parallel applications for GPU architectures. System theory concepts are used to model dynamic systems, and to interface dynamic systems to computation elements and communication networks. They are mainly investigated from the point of view of the design of robotic tele-operated systems, virtual environments for surgical applications, mobile robots and multi-robot systems, and optimal co-design of communication and control strategies for networked and embedded control systems. Finally, research in communication is focused on the design, analysis and evaluation of network protocols and architectures, considering all layers, from data link, to routing, to congestion control, to overlay; moreover, with the so-called network synthesis, computation, communication and control aspects are addressed in a holistic way to face the complexity of large pervasive applications.

## LABORATORIES

- Altair:** Non conventional Robotics
- ESD/NES:** Techniques for automatic design of electronics Systems and networks
- PARCO:** Parallel Computing

## PROJECTS (2012-2016)

- **TOUCHMORE:** Automatic Customizable Tool-chain for Heterogeneous Multicore Platform Software Development. A FP7 EU project aiming at creating an innovative tool chain for the automatic generation of code running on a multicore platform.
- **INTCATCH:** (Development and application of Novel, Integrated Tools for monitoring and managing Catchments) is an H2020 project that has the objective to improve the techniques for monitoring and managing waterbodies such as lakes and rivers. UNIVR will develop autonomous and radio controlled boats to provide better access and coverage of such waterbodies.
- **MURAB:** (MRI and Ultrasound Robotic Assisted Biopsy) is an H2020 project that has the objective to improve the techniques of breast cancer diagnosis by combining medical image processing and fusion with robotic accuracy and repeatability.
- **ROBIOPSY:** is a project funded by the Italian Ministry of Foreign Affairs and International Cooperation (MAECI) to develop a robotic system that could guide a physician during ultra-sound monitored prostate biopsy.

## SELECTED PUBLICATIONS (2012-2016)

- Farinelli, A., Nardi, D., Pigliacampo, R., Rossi, M., Settembre, G.P. Cooperative situation assessment in a maritime scenario. *International Journal of Intelligent Systems*, 27 (5), pp. 477-501, 2012.
- D. Carra, M. Steiner, P. Michiardi, E. Biersack, W. Effelsberg, T. En-Najjary. Characterization and Management of Popular Content in KAD "IEEE Transactions on Parallel and Distributed Systems". Vol. 24, n. 4, pp. 662-671, 2013.
- Nuzzo P., Sangiovanni-Vincentelli A., Bresolin D., Geretti L., Villa T. A Platform-Based Design Methodology with Contracts and Related Tools for the Design of Cyber-Physical Systems *Proceedings of the IEEE*, vol. 103, n. 11, pp. 2104-2132, 2015.
- N. Bombieri; F. Fummi; V. Guarnieri; G. Pravadelli. Testbench qualification of SystemC TLM protocols through Mutation Analysis "IEEE Transactions on Computers". Vol. 63, n. 5, pp. 1248-1261, 2014.
- L. Repele, R. Muradore, D. Quaglia, P. Fiorini. Improving Performance of Networked Control Systems by Using Adaptive Buffering "IEEE Transactions on Industrial Electronics". Vol. 61, n. 9, pp. 4847-4856, 2014.
- M. Dell'Amico, D. Carra, P. Michiardi. PSBS: Practical Size-Based Scheduling. "IEEE Transaction on Computers". Vol. 65, n. 7, pp. 2199-2212, 2016.
- E. Ebeid, F. Fummi, D. Quaglia. Model-Driven Design of Network Aspects of Distributed Embedded Systems "IEEE Transactions on CAD/ICAS". Vol. 34, n. 4, pp. 603-614, 2015.
- A. Calanca, R. Muradore, P. Fiorini. A Review of Algorithms for Compliant Control of Stiff and Fixed-Compliance Robots "IEEE Transactions on Mechatronics". Vol. 21, n. 2, pp. 613-624, 2016.

## PEOPLE (2017)



**Nicola Bombieri**  
Assistant Professor  
nicola.bombieri@univr.it  
+39 045 802 7094



**Damiano Carra**  
Assistant Professor  
damiano.carra@univr.it  
+39 045 802 7059



**Andrea Calanca**  
Assistant Professor  
andrea.calanca@univr.it  
+39 045 802 7074



**Alessandro Farinelli**  
Associate Professor  
alessandro.farinelli@univr.it  
+39 045 802 7842



**Paolo Fiorini**  
Full Professor  
paolo.fiorini@univr.it  
+39 045 802 7963



**Franco Fummi**  
Full Professor  
franco.fummi@univr.it  
+39 045 802 7994



**Riccardo Muradore**  
Assistant Professor  
riccardo.muradore@univr.it  
+39 045 802 7835



**Graziano Pravadelli**  
Associate Professor  
graziano.pravadelli@univr.it  
+39 045 802 7081



**Davide Quaglia**  
Assistant Professor  
davide.quaglia@univr.it  
+39 045 802 7811



**Tiziano Villa**  
Full Professor  
tiziano.villa@univr.it  
+39 045 802 7034

