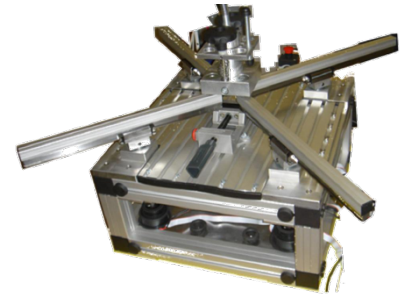


Functional Sample: Parallel Kinematic Machine Robot and Its Real-Time Control from Linux OS

Květoslav Belda
Department of Adaptive Systems
Institute of Information Theory and Automation
Academy of Sciences of the Czech Republic

Pavel Píša, Michal Sojka, Rostislav Lisový
Department of Control Engineering - K13135
Faculty of Electrical Engineering
Czech Technical University in Prague



The participation at the exhibition was realized by the Department of Control Engineering, FEE, CTU in Prague as an academic member of Open Source Automation Development Lab (OSADL, <http://www.osadl.org/>). The OSADL group invited academic members to be its co-exhibitors and promoted all activities connected with the preparation and the final exhibition realization.



Hall 5, OSADL Booth No. 276

<http://dce.fel.cvut.cz/spoluprace/vystavujeme-na-veletrhu-embedded-world-2014>

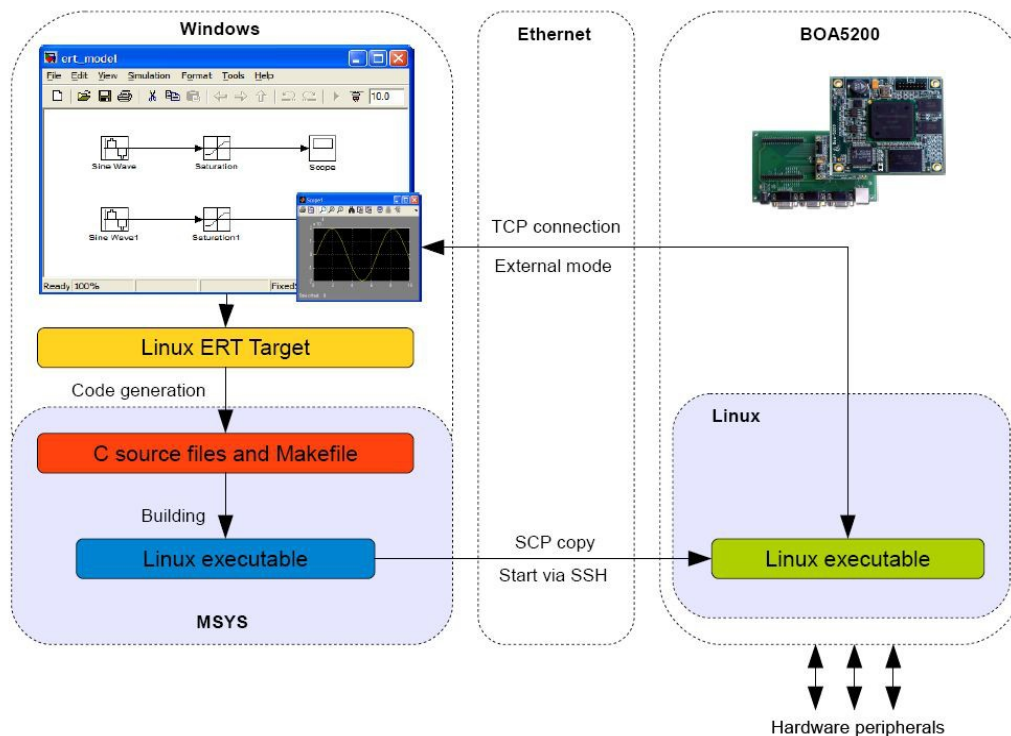
Linux Code Generation Target for Simulink Embedded Real-Time (ERT)

Czech Technical University in Prague, FEE, Department of Control Engineering

<http://dce.fel.cvut.cz/>

Linux ERT target for MathWorks' Simulink Embedded Coder® allows to compile a model of designed control system to the C-code and to combine it with target specific support functions.

The resulting executable/controller can be run in real-time on the target Linux system. The running dynamic system can be augmented via tunable block parameters in the Simulink model and data can be acquired and visualized with Simulink scopes.



Linux ERT target heavily uses real-time capabilities of real-time variant of the Linux kernel. The resulting control system supports sampling frequencies up to 20 kHz.

With carefully selected x86 or embedded hardware, such system can run for months without missing a single deadline (see OSADL Quality Assurance Farm:

<http://www.osadl.org/QA-Farm-Realtime.qa-farm-about.0.html>).

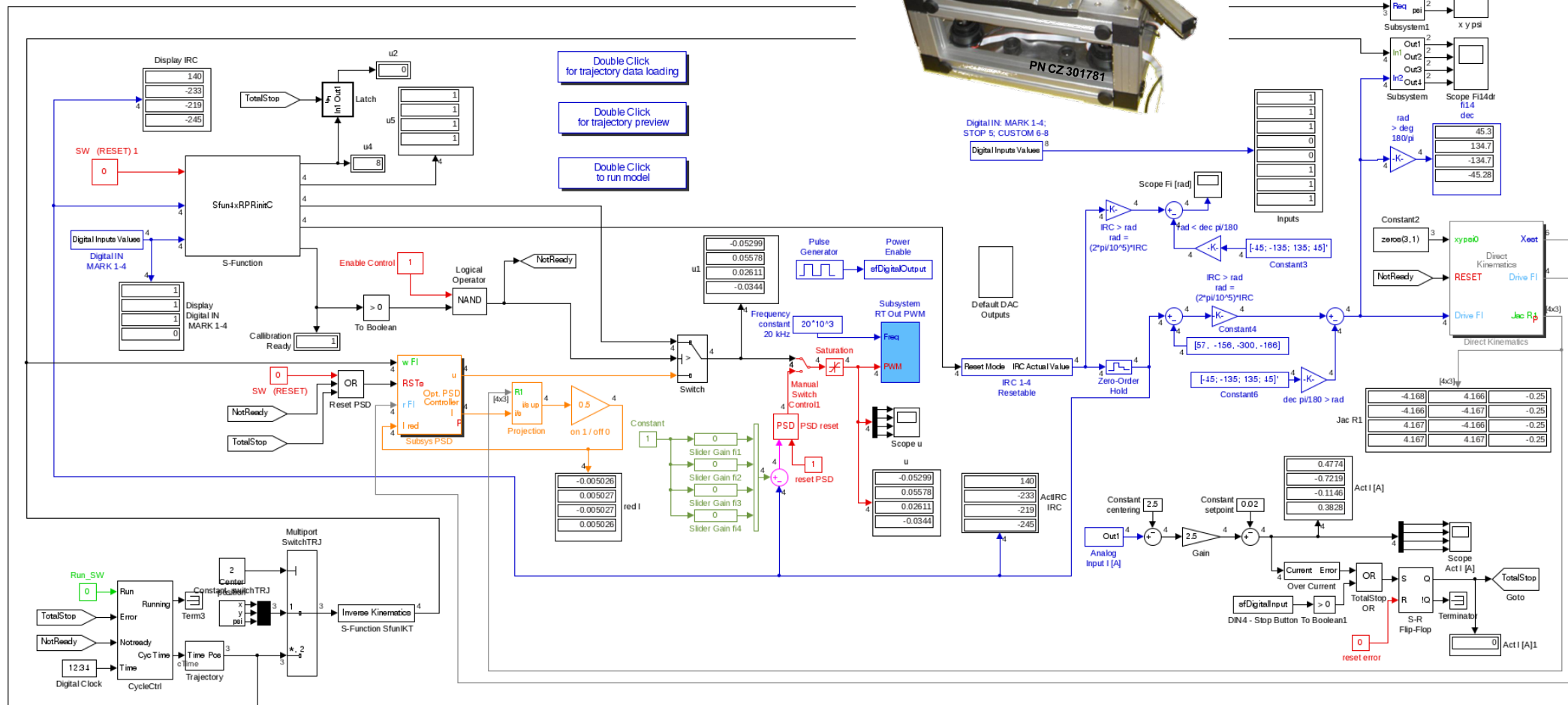
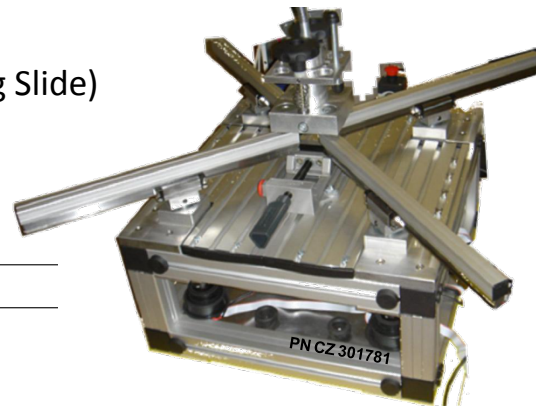
The target includes Simulink blockset for communication with CANopen protocol and for accessing multifunction data acquisition I/O cards.

Further information:

- Lintarget project at Source Forge:
<http://lintarget.sourceforge.net/>
project download area contains Linux ERT target and a CANopen blockset.
- Linux ERT target source code:
http://rtime.felk.cvut.cz/gitweb/ert_linux.git
version updated for real-time and native GNU/Linux host/target system setup.
- Humusoft MF624 I/O card blockset:
<http://rtime.felk.cvut.cz/gitweb/mf624-simulink.git>
initial version of blockset supporting analog and digital input/output, IRC, PWM and PWM measurement for MF624 cards.

Example of ERT Linux Target

Realization of the control for parallel kinematic machine robot (Moving Slide)
developed at the Department of Adaptive Systems
Institute of Information Theory and Automation
Academy of Sciences of the Czech Republic



More information about ERT Linux target is available
at project page: <http://lintarget.sourceforge.net/>

Detailed information about parallel kinematic robot control and predictive control
in general can be found at <http://as.utia.cz/asc/GPCweb/GPC.php.cs.utf8>
at Adaptive Systems Department <http://as.utia.cz/asc/>, <http://www.utia.cas.cz/AS>

Top Milling Machine Tools and Their Advanced Control

Belda, K.

Institute of Information Theory and Automation AS CR, Prague, Czech Republic

Perspectives in machine tools

Aim is to push forward kinematical and dynamical limits with efficient utilization of input energy. Possible ways to achieve this aim may be the following:

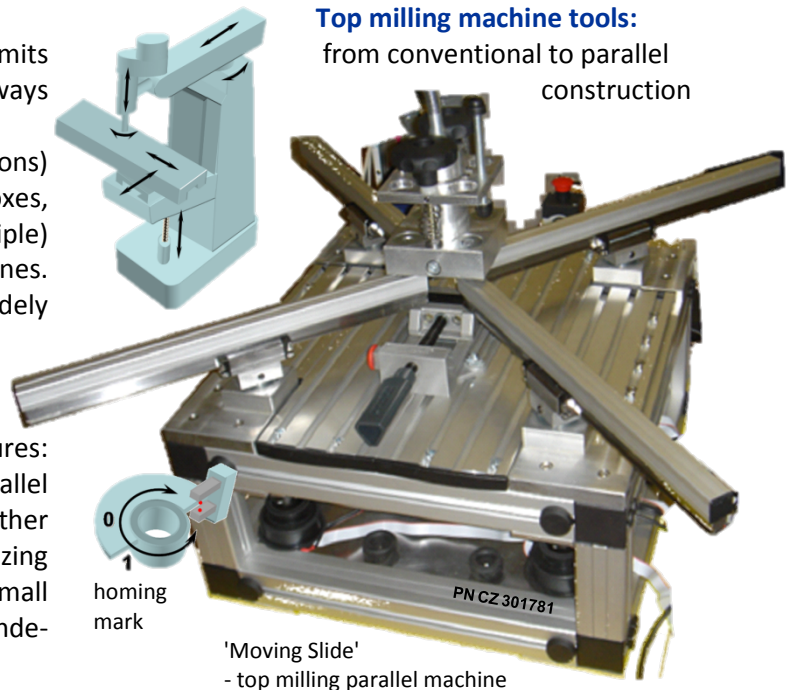
- design of new machines (new parallel constructions)
 - application of new drives (backlash-free gearboxes, linear motors employ a direct electromag. principle)
 - advanced control for drive units or whole machines.
- All is valid for top milling machine tools used widely in industrial production due to their universality.

Start-up operations: homing & calibration

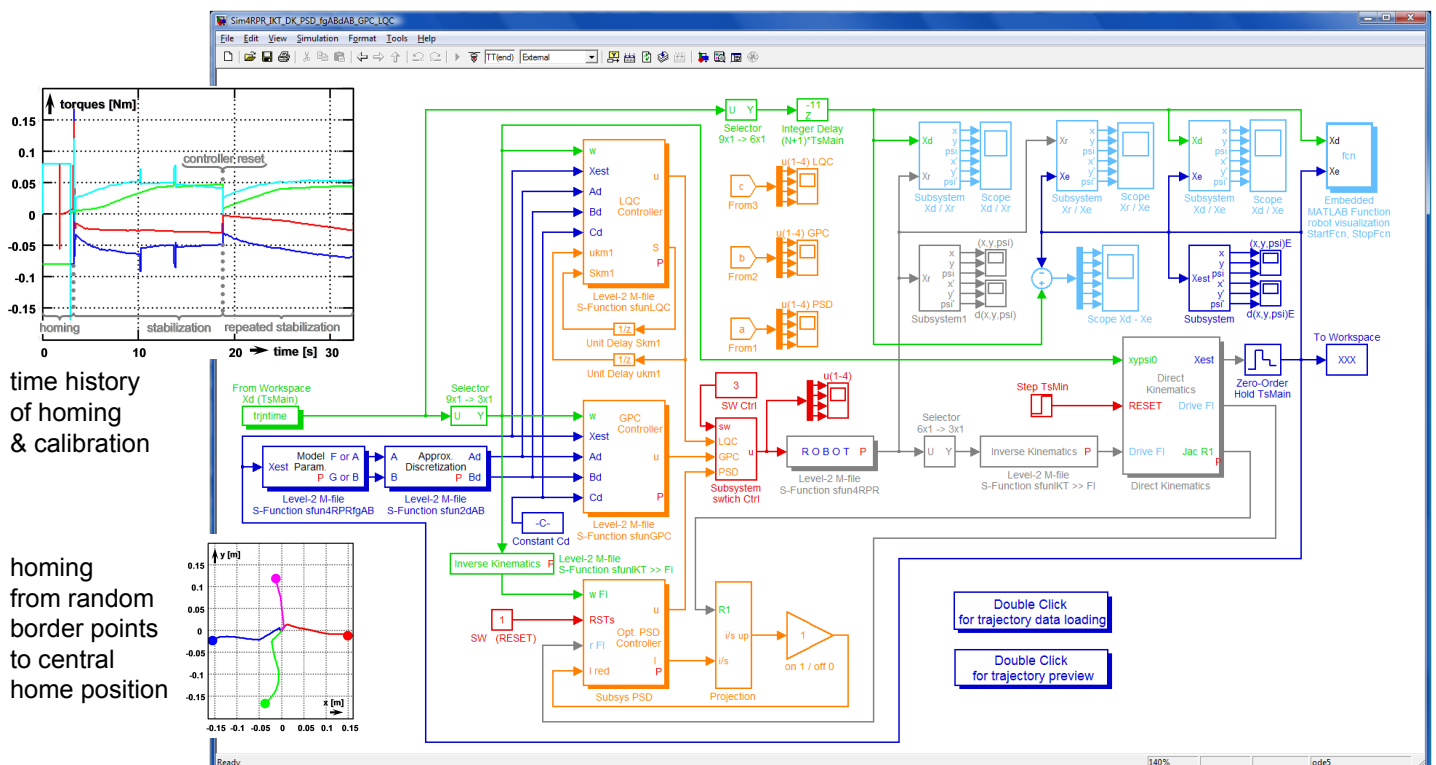
New machine configurations call for new procedures: homing, due to possible structural collisions in parallel constructions, requires to operate all drives together up to predefined home position; calibration, initializing local sensors, should run individually, limited to small vicinity of definite e.g. home position, otherwise undefined structure motion may occur.

Control operation: conventional x advanced control

Control may be realized either as a local independent drive control or as a global complete machine control. The former, conventional control, needs to compensate for mutual unproductive actions of parallel coupling, opposite to this approach, the latter, advanced control, generates efficient control actions without undesirable effects. The diagram below shows appropriate control circuits used for top milling parallel machine.



'Moving Slide'
- top milling parallel machine



Institute of Information Theory and Automation (UTIA)



UTIA's Building in Prague

Mission

The Institute is involved in fundamental as well as applied research in computer science, artificial intelligence, stochastic informatics, systems and control theory, signal and image processing, pattern recognition, and econometrics. It contributes to increasing the level of knowledge and education and to applications of research results in practice. The Institute publishes the journal *Kybernetika*.

Institute Highlights

- Wide international cooperation activities, participation in EU-funded projects, and bilateral agreements & contracts: <http://www.utia.cz/grants>
- Long-term R&D in concepts, theory, algorithms, software and applications: <http://www.utia.cz/research>

Key Relevant Research Fields and Competence Areas

- Control & Decision Making Theory - adaptive control, model-based control, Bayesian estimation, prediction with link to various industrial applications, robotics, mechatronics.
- Signal Processing - digital signal processing algorithms, parallel algorithms and architectures, field-programmable gate arrays, embedded systems.
- Image Processing - image fusion, image registration, distorted object recognition, content-based image retrieval.
- Pattern Recognition - statistical model-based pattern recognition, modelling of random fields for scene interpretation, statistical feature selection.

Adaptive Systems

The Department of Adaptive Systems focuses predominantly on the design of decision-making systems. The essential ability – adaptivity – enhances their efficiency. Decades of research have brought a number of conceptual, theoretical, algorithmic, software and application results.

The departmental “know-how” serves to resolve national as well as international research projects in collaboration with industry and government agencies: <http://www.utia.cz/AS/partners>

The topics of interest include control of technological systems, drive control, industrial robotics, mechatronic and automobile applications with focus on system modelling, data analysis and estimation.

The applicability of adaptive systems is currently being extended towards complex scenarios by improving the classical adaptive systems and by developing their new versions.

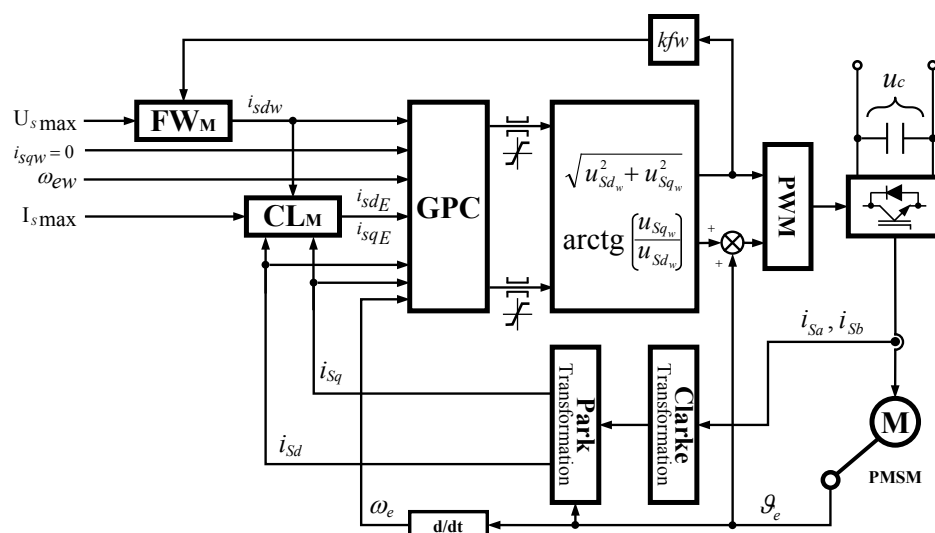
The increasing complexity of the problems addressed directs the main stream of the research towards decentralized control of large-scale systems and normative decision-making. The interplay between theory and limited computing power is the common issue linking various domains.

Contact:

Ing. Květoslav Belda, Ph.D.
Department of Adaptive Systems

Institute of Information Theory and Automation
Academy of Sciences of the Czech Republic
Pod Vodárenskou věží 4
182 08 Prague 8, Czech Republic

Phone: +420 26605-2310
E-Mail: belda@utia.cas.cz
Www: www.utia.cz/AS
as.utia.cz/asc



Advanced Model-based Generalized Predictive Control for PMSM Drives