# DEPARTMENT OF SYSTEMS AND CONTROL
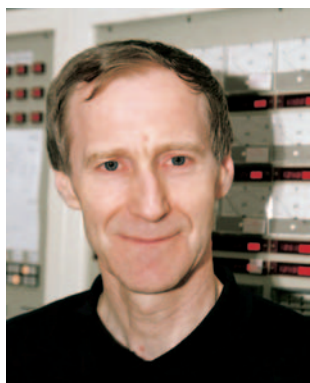# E-2

**The Department of Systems and Control is engaged in research, development, applications and education in the area of control technology. These activities are being performed in close cooperation with the Faculty of Electrical Engineering of the University of Ljubljana and the engineering company INEA. These three institutions make a consortium referred to as the "Technology vertical", the aim of which is to merge expertise and knowledge transfer. To further stimulate cooperation with industry, a technology centre referred to as ConTech Centre, has been established within the Department.**

Head:

**Prof. Stanislav Strmčnik**

### Basic and applied research

Research in the area of **fault detection** and **isolation** has continued in the area of robust detection in the presence of modelling errors. Proper handling of modelling errors helps in reducing false alarms. In the problem set up the stochastic description of the modelling errors has been employed. Research was focused on analysis of underlying statistical tests and extension of the concept to the parity relations approach. In addition, part of the research was devoted to investigating new approaches to the diagnosis of nonlinear systems represented by Gaussian mixture models. The ideas were experimentally verified on a gas-conditioning unit.
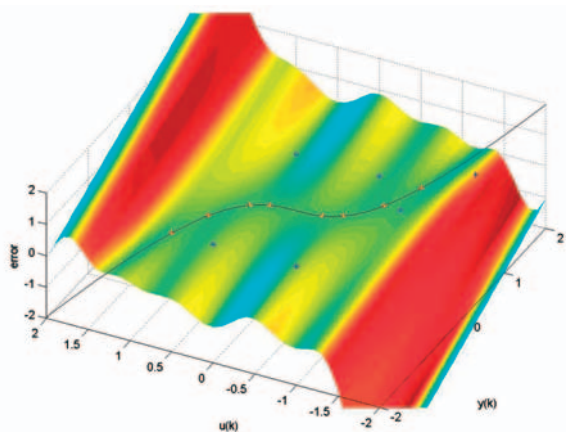


Figure 1: Error surface between system and Gaussian Process model. Modelling data are given with coloured asterixes.

In the area of **process control and optimization** the research efforts were directed towards nonlinear multimodel based control, industrial controller tuning systems and use of probabilistic models, namely Gaussian process models, for dynamic systems modelling and control (Fig. 1).

The second part of research in this area concerned control of wastewater treatment processes. Research within the EU 5th FP project "SMAC – SMArt Control of wastewater systems" addressed the design of advanced algorithms for control of the nitrification process in a wastewater treatment plant, with the aim of improving the effluent quality and reducing energy consumption. A mathematical process model was developed, which was then used in predictive and nonlinear internal model control algorithms to control the real plant. Testing on the real plant was performed in MATLAB environment with the on-line internet connection to the existing control and information system on the real plant.

Research in **computer integrated production** took three directions. The majority of activities were devoted to the 5th FP project "Virtual Plant Wide Management and Optimization of Responsive Manufacturing Networks". In this project our group was responsible for the development of an on-line algorithm for batch sequences in a case study process of two-stage gel washing at Cinkarna Celje d.d.

In the area of software (domain) engineering we have carried on the research concerning the design of a model of the process control domain, the specifications of the previously developed ProcGraph notation and the automatic transformation of the specifications into programme code.

The third sub-area concerns non-technical aspects of control technology. In this frame, two methods for design and evaluation of human-centred technologies, namely the Dual Design Method and the KOMPASS method, were evaluated using practical examples.

### R & D projects

In the frame of a long term cooperation with the companies INEA and MITSUBISHI, the work on particular segments of the previously developed blow-moulding machine control systems was carried on. In this context a special hydraulic set-up was also designed. The set-up enables testing of high speed hydraulic positioning at 1 m/s and accelerations of over 10 m/s$^2$, while loads may be changed from 0-50 kg at vertical or horizontal positioning. The work related to industrialization of a prototype incorporating advanced control algorithms in programmable logic controllers (ASPECT) has been also continued, with emphasis on testing the prototype on pilot applications.

In the company Domel, Železniki, a method for the detection of characteristic mechanical faults of vacuum cleaner motors has been developed. The method is capable of detecting mechanical

**The researchers of the department have contributed substantially to the establishment of the technology network "Process control technology", which was initiated by the Ministry of Economics and consists of major business and academic players in this field in Slovenia.**

In addition to the larger projects mentioned above, part of our work was devoted to smaller projects for the companies Mitol, Kovinoplastika, Čistilna naprava Domžale-Kamnik and ALTEX d.o.o.

Finally, we have devoted a substantial part of our activities to establishing the technology network referred to as "Process Control Technology", which was initiated and co-financed by the Ministry of Economics. The network consists of 11 companies (solutions and equipment providers) and 3 academic institutions. It aims to constitute the basic instrument for making a breakthrough in the field of control, automation and computer supported processes in Slovenian companies.

### Education Activities

Some members of the department are giving lectures and practical courses at the Faculty of Electrical Engineering, University of Ljubljana and the Polytechnic of Nova Gorica. They also act as supervisors of M.Sc and Ph.D. students. Special care was dedicated to post-qualification training for engineers from industry. In 2003 three one-week courses were organized. These activities were organized in close co-operation with the Information Technologies Knowledge transfer Centre at the Institute.

## Some outstanding publications in the past three years

1.  Gregor Dolanc, Stanko Strmčnik, Janko Petrovčič. $NO_x$ selective catalytic reduction control based on simple models. J. Process control. [Print ed.], 2001, vol. 11, str. 35-51.
2.  Đani Juričić, Mina Žele. Robust detection of sensor faults by means of a statistical test. Automatica (Oxf.). [Print ed.], 2002, vol. 38, str. 737-742.
3.  Damir Vrančić, Stanko Strmčnik, Đani Juričić. A magnitude optimum multiple integration tuning method for filtered PID controller. Automatica (Oxf.). [Print ed.], 2001, vol. 37, str. 1473-1479.
4.  Darko Vrečko, Nadja Hvala, Juš Kocijan. Wastewater treatment benchmark : What can be achieved with simple control?. Water sci. technol., 2002, vol. 45, str. 127-134.

## The most important technological achievement in the past three years

1.  A control system for a magneto-focused plasma annealer (G. Dolanc, S. Gerkšič)



**Figure 2: Magneto-focused plasma annealer control system**

imperfections in the turbo-wheel, detection of rubbing between the turbo-wheel and cover as well as isolation of faults in bearing. In addition, two prototype test cells were designed and tested, i.e. an axial play test cell and a vibration test cell.

For the company Danfoss Trata a system for pressure difference control of the hydraulic testing line was developed and implemented. Basically, the system adjusts the speed of rotation of existing pumps in such a manner that the pressure difference follows the set-point value as closely as possible. To meet the specific requirements some advanced control solutions, together with a set of additional control and supervision functions, had to be implemented.

For the Austrian company PlasmaIt, a control system was developed for a new and modern magneto-focused plasma annealer capable of annealing and cleaning wire surfaces (Fig. 2). The control system is composed of the following functional units: electrode power management, adaptive pressure control and atmosphere preparation, control of peripheral systems, co-ordination of operating regimes and system diagnostics.

A part of our R&D work was devoted to problems of automatic tuning of controllers of HVAC systems in the pharmaceutical company LEK, d.d.. In this frame experimental modelling of the processes was carried out, together with development of the corresponding tuning algorithms, based on measured signals, and the design of a prototype tool in DELPHI.

# BIBLIOGRAPHY

## ORIGINAL ARTICLES

1.  Janko Černetič
    On cost-effectiveness of human-centered and socially acceptable robot and automation systems
    In: Robotica, Vol. 21, pp. 223-232, 2003.
2.  Gregor Kandare, Giovanni Godena, Stanko Strmčnik
    A new approach to PLC software design
    In: ISA trans., Vol. 42, pp. 279-288, 2003.
3.  Rihard Karba, Maja Atanasijević-Kunc, Aleš Belič, Juš Kocijan, Janko Petrovčič
    Vloga senzorjev v sistemih vodenja procesov
    In: Inf. MIDEM, Letn. 33, No. 1, pp. 41-44, 2003.
4.  David J. Murray-Smith, Juš Kocijan, Mingrui Gong
    A signal convolution method for estimation of controller parameter sensitivity functions for tuning of feedback control systems by an iterative process
    In: Control engineering practice, Vol. 11, pp. 1087-1094, 2003.

5.  Dejan Tinta, Janko Petrovčič, Jože Tavčar, Aneta Stefanovska, Mina Žele, Jožica Rejec, Andrej Rakar, Đani Juričić
    Eksperimentalno okolje za odkrivanje napak na sesalnih enotah
    In: Elektroteh. vestn., Vol. 70, pp. 285-290, 2003.
6.  Darko Vrečko, Nadja Hvala, Bengt Carlsson
    Feedforward-feedback control of an activated sludge process-a simulation study
    In: Water sci. technol., Vol. 47, pp. 19-26, 2003.
7.  Sebastjan Zorzut, Giovanni Godena, Vladimir Jovan
    Primer uporabe integriranega orodja za vodenje procesov
    In: Elektroteh. vestn., Let. 70, pp. 26-33, 2003.
8.  Janko Petrovčič, Igor Steiner, Boris Kramar
    Precizno hidravlieno pozicioniranje s koprocesorskim modulom SPAC20
    In: Ventil (Ljubl.), Letn. 9, No. 3, pp. 147-152, 2003.
9.  Dejan Tinta, Uroš Benko, Janko Petrovčič, Đani Juričić, Mina Žele, Andrej Rakar, Jože Tavčar, Jožica Rejec
    Končna kontrola kakovosti sesalnih enot
    In: Ventil (Ljubl.), Let. 9, Št. 3, pp. 153-158, 2003.

# REVIEW ARTICLES, MONOGRAPHS AND SCIENTIFIC BOOKS

1. Janko Černetič
Change management for better acceptance of advanced technology
In: Kompetenzentwicklung 2003: Technik, Gesundheit, Ökonomie, Dietrich Brandt, Münster [et al.], Waxmann, 2003, pp. 43-49.

# PUBLISHED CONFERENCE PAPERS

1. Uroš Benko
Fault detection of vacuum cleaner motors through motor sound recorder during motor run-down
In: Workshop CD Rom, 4th PhD Workshop Information Technologies & Control, Young Generation Viewpoint, Spa Libverda, September 16-20, 2003, Květoslav Belda, ed., Roman Kytka, ed., Prague, Institute of Information Theory and Automation, Academy of Science of the Czecz Republic, 2003, pp. 111-117.

2. Uroš Benko, Janko Petrovčič, Đani Juričić, Jože Tavčar, Jožica Rejec
Quality end-test of vacuum cleaner motors based on sound analysis
In: Condition monitoring and diagnostic engineering management, (COMADEM 2003): proceedings of the 16th International Congress, 27-29 August 2003, Växjö, Sweden, Om P. Shrivastav, ed., Basim Al-Najjar, ed., Raj B. K. N. Rao, ed., Växjö, Växjö University Press, 2003, pp. 303-312.

3. Sašo Blažič, Igor Škrjanc, Samo Gerkšič, Gregor Dolanc, Stanko Strmčnik, Mincho B. Hadjinski, Anna Stathaki
On-line fuzzy identification for advanced intelligent controller
In: Proceedings, International conference on industrial technology [also] IEEE ICIT 2003, Hotel Habakuk Maribor, Slovenia, December 10-12, 2003, Piscataway, IEEE, 2003, pp. 912-916.

4. Gregor Dolanc, Samo Gerkšič, Juš Kocijan, Stanko Strmčnik, Damir Vrančić, Miha Božiček, Zoran Marinšek, Igor Škrjanc, Sašo Blažič, Anna Stathaki, R. King, Mincho B. Hadjinski, Kosta Boshnakov
ASPECT - advanced control algorithms on industrial controllers
In: Control systems design '03: 2nd IFAC Conference, Bratislava, Slovak Republic, September 7-10, 2003, [S.l.], IFAC, 2003, 6 str..

5. Gregor Dolanc, Samo Gerkšič, Juš Kocijan, Damir Vrančić, Stanko Strmčnik, Miha Božiček, Zoran Marinšek, Igor Škrjanc, Sašo Blažič
Aspect - napredni algoritmi vodenja na industrijskih krmilnikih
In: Avtomatizacija v industriji in gospodarstvu: zbornik tretje konference AIG'03, 10. in 11. april 2003, Maribor, Slovenia, Boris Tovornik, ed., Nenad Muškinja, ed., [Maribor], Društvo avtomatikov Slovenije, 2003, pp. 62-67.

6. Samo Gerkšič, Juš Kocijan, Stanko Strmčnik, Gregor Dolanc, Damir Vrančić, Igor Škrjanc, Sašo Blažič, Miha Božiček, Zoran Marinšek, Mincho B. Hadjinski, Kosta Boshnakov, Robert King, Anna Stathaki
ASPECT: industrial self-tuning nonlinear controller on a PLC
In: The IEEE Region 8 EUROCON 2003: computer as a tool: proceedings, 22-24. September 2003, Faculty of Electrical Engineering, University of Ljubljana, Ljubljana, Slovenia, Baldomir Zajc, ed., Marko Tkalčič, ed., Piscataway, IEEE, cop. 2003, Zv. A, pp. 357-361.

7. Samo Gerkšič, Damir Vrančić, Gregor Dolanc, Juš Kocijan, Stanko Strmčnik, Igor Škrjanc, Sašo Blažič, Miha Božiček, Zoran Marinšek
Samonastavljivi nelinearni regulator na programabilnem logičnem krmilniku
In: Zbornik dvanajste mednarodne Elektrotehniške in računalniške konference ERK 2003, 25. - 26. september 2003, Ljubljana, Slovenija(Zbornik ... Elektrotehniške in računalniške konference ERK ..., 1581-4572), Baldomir Zajc, ed., Ljubljana, IEEE Region 8, Slovenska sekcija IEEE, 2003, Zv. A, pp. 145-148.

8. A. Grancharova, Tor Arne Johansen, Juš Kocijan
Explicit model predictive control of gas-liquid separation plant
In: ECC'03: European Control Conference, 1-4 September 2003,Cambridge, UK, [S.l.], The IEE, 2003, 6 str..

9. Alexandra Grancharova, Tor Arne Johansen, Juš Kocijan, Damir Vrančić
Design of reduced dimension explicit model predictive controller for a gas-liquid separation plant
In: The IEEE Region 8 EUROCON 2003: computer as a tool: proceedings, 22-24. September 2003, Faculty of Electrical Engineering, University of Ljubljana, Ljubljana, Slovenia, Baldomir Zajc, ed., Marko Tkalčič, ed., Piscataway, IEEE, cop. 2003, Zv. A, pp. 391-395.

10. Mincho B. Hadjinski, Stanko Strmčnik, Kosta Boshnakov, Samo Gerkšič, Nikolinka Christova, Juš Kocijan
On-line control performance monitor with robust properties
In: Proceedings, International conference on industrial technology [also] IEEE ICIT 2003, Hotel Habakuk Maribor, Slovenia, December 10-12, 2003, Piscataway, IEEE, 2003, pp. 918-922.

11. Boštjan Hauptman, Vladimir Jovan
Razvrščanje v procesni industriji
In: Avtomatizacija v industriji in gospodarstvu: zbornik tretje konference AIG'03, 10. in 11. april 2003, Maribor, Slovenija, Boris Tovornik, ed., Nenad Muškinja, ed., [Maribor], Društvo avtomatikov Slovenije, 2003, pp. 30-37.

12. Vladimir Jovan, Boštjan Hauptman
A simple on-line batch sequencing algorithm
In: ETFA 2003: 2003 IEEE Conference on Emerging Technologies and Factory Automation, September 16-19, 2003, Lisbon, Portugal: proceedings, Piscataway, IEEE, 2003, pp. 220-223.

13. Gregor Kandare
Code generation for programmable logic controllers
In: Workshop CD Rom, 4th PhD Workshop Information Technologies & Control, Young Generation Viewpoint, Spa Libverda, September 16-20, 2003, Květoslav Belda, ed., Roman Kytka, ed., Prague, Institute of Information Theory and Automation, Academy of Science of the Czecz Republic, 2003, pp. 103-110.

14. Juš Kocijan, Blaž Banko, Bojan Likar, Agathe Girard, Roderick Murry-Smith, Carl Edward Rasmussen
A case based comparison of identification with neural network and Gaussian process models
In: [Preprints], International Conference on Intelligent Control Systems and Signal Processing ICONS 2003, University of Algarve, Portugal, 8-11 April 2003, A. E. Ruano, ed., Algarve, APCA, CSI, 2003, Zv. 1, pp. 137-142.

15. Juš Kocijan, A. Girard, Blaž Banko, R. Murray-Smith
Dynamic systems identification with Gaussian processes
In: Proceedings(ARGESIM Report, no. 24), 4th MATHMOD Vienna, 4th IMACS Symposium on Mathematical Modelling, February 5-7, 2003, Vienna University of Technology, Austria, Inge Troch, ed., Felix Breitenecker, ed., Vienna, ARGESIM, 2003, Vol. 2, pp. 776-784.

16. Juš Kocijan, Roderick Murray-Smith, Carl Edward Rasmussen, Bojan Likar
Predictive control with Gaussian process models
In: The IEEE Region 8 EUROCON 2003: computer as a tool: proceedings, 22-24. September 2003, Faculty of Electrical Engineering, University of Ljubljana, Ljubljana, Slovenia, Baldomir Zajc, ed., Marko Tkalčič, ed., Piscataway, IEEE, cop. 2003, Zv. A, pp. 352-356.

17. Juš Kocijan, Damir Vrančić, Gregor Dolanc, Samo Gerkšič, Stanko Strmčnik, Igor Škrjanc, Sašo Blažič, Miha Božiček, Zoran Marinšek, Mincho B. Hadjinski, Kosta Boshnakov, Anna Stathaki, Robert King
Auto-tuning non-linear controller for industrial use
In: Proceedings, International conference on industrial technology [also] IEEE ICIT 2003, Hotel Habakuk Maribor, Slovenia, December 10-12, 2003, Piscataway, IEEE, 2003, pp. 906-910.

18. Janko Petrovčič, Igor Steiner, Boris Kramar
Precizno hidravleno pozicioniranje s koprocesorskim modulom SPAC20
In: Avtomatizacija v industriji in gospodarstvu: zbornik tretje konference AIG'03, 10. in 11. april 2003, Maribor, Slovenia, Boris Tovornik, ed., Nenad Muškinja, ed., [Maribor], Društvo avtomatikov Slovenije, 2003, pp. 194-199.

19. Andrej Rakar
Model-based fault detection of vacuum cleaner motors
In: ECC'03: European Control Conference, 1-4 September 2003,Cambridge, UK, [S.l.], The IEE, 2003, 6 str..

20. Andrej Rakar
Fault diagnosis of a gas conditioning unit by means of mixture modelling
In: Workshop CD Rom, 4th PhD Workshop Information Technologies & Control, Young Generation Viewpoint, Spa Libverda, September 16-20, 2003, Květoslav Belda, ed., Roman Kytka, ed., Prague, Institute of Information Theory and Automation, Academy of Science of the Czecz Republic, 2003, pp. 18-28.

21. Jože Tavčar, Uroš Benko, Janko Petrovčič, Đani Juričić, Jožica Rejec
Sound analysis and quality control of vacuum cleaner motors
In: Proceedings of the First Congress of Alps Adria Acoustics Association and Third Congress of Slovenian Acoustical Society, Portorož, Slovenija, September 1-2, 2003, Mirko Čudina, ed., Ljubljana, Slovenian Acoustical Society at Faculty of Mechanical Engineering, 2003, pp. 633-640.

22. Dejan Tinta
Monitoring the quality of communication in universal electrical motors
In: Workshop CD Rom, 4th PhD Workshop Information Technologies & Control, Young Generation Viewpoint, Spa Libverda, September 16-20, 2003, Květoslav Belda, ed., Roman Kytka, ed., Prague, Institute of Information Theory and Automation, Academy of Science of the Czecz Republic, 2003, pp. 89-95.

23. Dejan Tinta, Uroš Benko, Janko Petrovčič, Đani Juričić, Mina Žele, Andrej Rakar, Jože Tavčar, Jožica Rejec
Prototip sistema za avtomatsko kontrolo kakovosti sesalnih enot
In: Avtomatizacija v industriji in gospodarstvu: zbornik tretje konference AIG'03, 10. in 11. april 2003, Maribor, Slovenija, Boris Tovornik, ed., Nenad Muškinja, ed., [Maribor], Društvo avtomatikov Slovenije, 2003, pp. 153-158.

24. Dejan Tinta, Janko Petrovčič, Uroš Benko, Đani Juričić, Andrej Rakar, Mina Žele, Jože Tavčar, Jožica Rejec, Aneta Stefanovska
A diagnostic system for vacuum cleaner motors
In: SAFEPROCESS 2003: preprints, 5th IFAC Symposium on fault detection, supervision and safety of technical processes, Washington, D.C., USA, June 9-11, 2003, [S.l.], IFAC, 2003, pp. 921-926.

25. Damir Vrančić
Improving closed-loop tracking and disturbance rejection performance
In: Workshop CD Rom, 4th PhD Workshop Information Technologies & Control, Young Generation Viewpoint, Spa Libverda, September 16-20, 2003, Květoslav

Belda, ed., Roman Kytka, ed., Prague, Institute of Information Theory and Automation, Academy of Science of the Czecz Republic, 2003, pp. 96-102.

26. Damir Vrančić, Stanko Strmčnik, Mikulas Huba
Improving tracking performance disturbance-rejection controllers
In: Control systems design '03: 2nd IFAC Conference, Bratislava, Slovak Republic, September 7-10, 2003, [S.l.], IFAC, 2003, 6 str..

27. Sebastjan Zorzut
Manufacturing performance indicators for improving enterprise efficiency
In: Workshop CD Rom, 4th PhD Workshop Information Technologies & Control, Young Generation Viewpoint, Spa Libverda, September 16-20, 2003, Květoslav Belda, ed., Roman Kytka, ed., Prague, Institute of Information Theory and Automation, Academy of Science of the Czecz Republic, 2003, pp. 118-125.

28. Sebastjan Zorzut, Giovanni Godena, Vladimir Jovan
Vzpostavitev informacijske podpore vodenju proizvodnje v manjšem podjetju
In: Avtomatizacija v industriji in gospodarstvu: zbornik tretje konference AIG'03, 10. in 11. april 2003, Maribor, Slovenija, Boris Tovornik, ed., Nenad Muškinja, ed., [Maribor], Društvo avtomatikov Slovenije, 2003, pp. 204-209.

# TECHNICAL REPORTS

1. Janko Černetič, Stanko Strmčnik, Rihard Karba, Zoran Marinšek
Vizija in strateški cilji tehnološke mreže na področju vodenja procesov v Sloveniji
(IJS delovno poročilo, 8840), 2003.

2. Gregor Dolanc
Naprava za natančno regulacijo pretoka plina (Precision gas Flow Controller): navodila za uporabo
(IJS delovno poročilo, 8854), 2003.

3. Gregor Dolanc
Plasma glow control system: software for programmable logic controller, documentation
(IJS delovno poročilo, 8897), 2003.

4. Gregor Dolanc
Plasma glow control system: user manual
(IJS delovno poročilo, 8898), 2003.

5. Gregor Dolanc
Sistem za avtomatsko vodenje peči LINN: navodila za operaterje
(IJS delovno poročilo, 8850), 2003.

6. Gregor Dolanc
Sistem za regulacije in krmiljenje linije SSSL, Hladna valjarna, Acroni Jesenice: navodila za uporabo
(IJS delovno poročilo, 8849), 2003.

7. Gregor Dolanc
Sistem za regulacije in krmiljenje linije SSSL, Hladna valjarna, Acroni Jesenice: projekt izvedbenih del
(IJS delovno poročilo, 8848), 2003.

8. Gregor Dolanc
Sistem za regulacijo koncentracije O2 in temperature pri procesu sintranja: dokumentacija programske opreme
(IJS delovno poročilo, 8851), 2003.

9. Gregor Dolanc
Sistem za regulacijo koncentracije O2 in temperature pri procesu sintranja: navodila za uporabo
(IJS delovno poročilo, 8852), 2003.

10. Gregor Dolanc
Sistem za regulacijo koncentracije O2 in temperature pri procesu sintranja, računalniški nadzorni sistem: navodila za uporabo
(IJS delovno poročilo, 8853), 2003.

11. Gregor Dolanc
Sistem za regulacijo tlačne razlike na testni liniji LAV, Danfos Trata, d.d.: navodila za uporabo in vzdrževanje
(IJS delovno poročilo, 8847), 2003.

12. Gregor Dolanc
Sistem za regulacijo tlačne razlike na testni liniji LAV, Danfos Trata, d.d.: projekt izvedbenih del
(IJS delovno poročilo, 8846), 2003.

13. Gregor Dolanc
Sistem za zajem podatkov iz naprave "Optimol SRV": navodila za uporabo in dokumentacijo
(IJS delovno poročilo, 8855), 2003.

14. Samo Gerkšič, Darko Vrečko, Nadja Hvala
Možnosti uporabe sodobnih algoritmov vodenja pri vodenju čistilnih naprav
(IJS delovno poročilo, 8829), 2003.

15. Boštjan Hauptman
Specifikacije algoritma za proženje šarž v postopku pranja gela pri proizvodnji $TiO_2$ v Cinkarni Celje: verzija 1.0
(IJS delovno poročilo, 8744), 2003.

16. Boštjan Hauptman, Vladimir Jovan
Testni zagon in validacija algoritma za proženje šarž v postopku pranja gela v Cinkarni Celje
(IJS delovno poročilo, 8906), 2003.

17. Vladimir Jovan, Boštjan Hauptman
Feasibility study of the two-stage gel washing sub-process scheduling/control in Cinkarna Celje d.d. Chemicalworks
(IJS delovno poročilo, 8902), 2003.

18. Vladimir Jovan, Boštjan Hauptman
Functional specifications for a scheduling algorithm in a process oriented factory (case study in Cinkarna Celje)
(IJS delovno poročilo, 8903), 2003.

19. Vladimir Jovan, Boštjan Hauptman
Tested and validation scheduler for the case study (at Cinkarna Celje d.d.)
(IJS delovno poročilo, 8904), 2003.

20. Juš Kocijan, Agathe Girard, Douglas J. Leith
Incorporating linear local models in Gaussian process model
(IJS delovno poročilo, 8895), 2003.

21. Andreja Marušič, Valentin Simonič, Janko Černetič
Načrtovanje socio-tehničnih in antropocentričnih sistemov: pregled internetnih strani
(IJS delovno poročilo, 8796), 2003.

22. Andreja Marušič, Valentin Simonič, Janko Černetič
Ocenjevanje antropocentričnosti sistema za vodenje šaržne nevtralizacije
(IJS delovno poročilo, 8797), 2003.

23. Andrej Rakar, Janko Černetič, Stanko Strmčnik
Tehnologija vodenja v tujini: stanje, trendi in tržne analize
(IJS delovno poročilo, 8834), 2003.

24. Franc Šink, Janko Petrovčič
Analiza vezij s programom SPICE
(IJS delovno poročilo, 8745), 2003.

25. Damir Vrančić, Samo Gerkšič
Poročilo o pregledu klimatskih naprav v obratu Viva in uglaševanju parametrov regulatorjev v podjetju Lek, d.d.
(IJS delovno poročilo, 8823, zaupno), 2003.

26. Sebastjan Zorzut
Uporaba OLAP orodij pri vodenju proizvodnje: preliminarna študija
(IJS delovno poročilo, 8788), 2003.

27. Mina Žele, Janko Černetič, Stanko Strmčnik
Anketa uporabnikov tehnologije vodenja: avtomatizacije in informatizacije
(IJS delovno poročilo, 8833), 2003.

28. Mina Žele, Stanko Strmčnik, Vladimir Jovan
Ocenjevanje stopnje tehnološke razvitosti slovenskih podjetij na področju tehnologije vodenja
(IJS delovno poročilo, 8838), 2003.

# POPULAR ARTICLE

1. Uroš Benko, Dejan Tinta, Janko Petrovčič, Đani Juričić, Mina Žele, Andrej Rakar, Jože Tavčar, Jožica Rejec
Sistem za avtomatsko kontrolo kakovosti sesalnih enot
In: Avtomatika (1999), Let. 5, No. 39, pp. 38-39, 2003, No. 40, pp. 39-40.

# LECTURES - GUEST LECTURES AT FOREIGN UNIVERSITIES

1. Juš Kocijan
ASPECT - auto-tuning nonlinear controller for industrial use: invited talk
Maynooth, Hamilton Institute, National University of Ireland, 30 Oct. 2003.

2. Juš Kocijan
Gaussian process based predictive control: invited talk
Cork, Ireland, University College Cork, Department of Electrical and Electronic Engineering, 21 Nov. 2003.

3. Juš Kocijan
Gaussian process models from control engineering perspective: invited talk
Belfast, United Kingdom, Queen's University, Department of Electrical and Electronic Engineering, 14 Nov.2003.

4. Andrej Rakar
Diagnostic system for quality assurance of vacuum cleaner motors
Prague, Czech Republic, Department of Adaptive Systems, Institute of Inorganic Theory and Automation, 3rd June 2003.

# THESES

## B. Sc. Theses

1. Klavdijo Cigoj:  Automatic control design for a jigsaw puzzle machine (Juš Kocijan)
2. Boštjan Gnezda: Automation of the process of electromotor assembling (Stanko Strmčnik)

## Ph. D. Thesis

1. Darko Vrečko: Design and comparison of control strategies for biological wastewater treatment plants (Rihard Karba)