

### International Federation of Automatic Control

# **INSTRUCTIONS FOR AUTHORS**

These instructions are for authors preparing scripts for presentation at IFAC technical meetings

This brochure has been compiled on behalf of the IFAC Publications Managing Board by:

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IFAC Publications website: www.elsevier.com/locate/ifac



Please ensure that you are using the latest version of this booklet. This version is dated February 2000.

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#### **IMPORTANT NOTICE**

An IFAC style file is available to assist authors working in LaTeX to meet the exact specifications in these instructions. It may be obtained by FTP from the CTAN archives at ftp.tex.ac.uk or ftp.dante.de, in the directory tex-archive/macros/latex/contrib/supported/ifacmtg

Should you have any difficulty with this style please contact our Author Services Department.E-mail: authors@elsevier.co.ukFax: +44 (0) 1865 843905Tel: +44 (0) 1865 843900

#### PUBLICATION OF PAPERS PRESENTED AT IFAC TECHNICAL MEETINGS

- 1. Papers presented at IFAC Symposia and Workshops may be published in the following ways:
  - 1.1 **As a paper in a Proceedings volume**. The author must send the paper in the required format (either as camera-ready copy or as electronic files) to the meeting editor and must attend the technical meeting in person or send a proxy to present his/her paper.
  - 1.2 **As an expanded paper in a special section of** *Automatica* **or** *Control Engineering Practice*. The technical meeting editor may recommend the paper to the editor-in-chief of either journal.
  - 1.3 As an expanded paper submitted independently by the author to Automatica or Control Engineering Practice. Even if the meeting editor does not recommend his/her paper to the editorin-chief of either Automatica or Control Engineering Practice, the author may submit his/her paper independently to either journal.
  - 1.4 **As a paper in a special issue or section of an IFAC-affiliated journal**. The meeting editor may recommend the paper to the journal editor, who will tell the author. The affiliated journal editor will establish that the paper is not being considered for *Automatica* or *Control Engineering Practice*.
  - 1.5 **As a paper in an IFAC-affiliated journal**. Provided that the paper has not been chosen for *Automatica* or *Control Engineering Practice*, the author may submit his/her paper independently to the affiliated journal of his/her choice. A list of IFAC-affiliated journals can be obtained by contacting the IFAC Secretariat.
- 2. The Proceedings of a technical meeting (1.1) will contain all the papers presented at the meeting which have passed the refereeing procedure of the meeting. There is no quota system as in the past. Proceedings volumes may be purchased from the publishers, Elsevier Science Ltd.
- 3. All papers published in Proceedings are recorded in *Control Engineering Practice*.

#### 4. Refereeing

Papers which appear in proceedings will have been refereed before being accepted for presentation. Papers for *Automatica, Control Engineering Practice* and IFAC-affiliated journals will be further refereed by the respective editors: substantial expansion and revision is often required to meet journal standards.

#### 5. **Copyright**

Authors must transfer the copyright in their papers to IFAC. If the paper is subsequently expanded and published in *Automatica, Control Engineering Practice* or an IFAC-affiliated journal (1.2–1.5), the copyright is automatically transferred to the journal under the provisions of the agreement between IFAC and Elsevier. If an author has not been notified that his/her paper is under consideration for one of these journals within three months after the meeting, he/she may submit the paper elsewhere, provided that he/she acknowledges its original publication in an IFAC Proceedings. Detailed copyright instructions are available from the IFAC Publisher.

#### 6. **Preparation of papers (1.1)**

Authors must follow the instructions exactly and must ensure that all parts of the paper are submitted. Papers which lack, for instance, an abstract or figure captions, may not be accepted for the preprints.

<u>CAUTION:</u> Papers may be omitted from the Preprints (by the Editor) or from the Proceedings (by the Publisher) if they do not conform to the following instructions.

SUBMISSION OF PAPERS: Manuscripts must be sent to the Conference organisers in the manner specified in the information letter which accompanies these Instructions. Generally, manuscripts are required either as camera-ready-copy (CRC), or in electronic format as Postscript or PDF files. Authors should ensure that, whichever method of transmittal is required, the following style and layout guidelines are adhered to exactly and that completed papers do not exceed the given page limit.

Manuscripts must be in English. Authors whose mother tongue is not English are advised to obtain the help of a suitable colleague to ensure that the typescript is clear and grammatically correct.

Use of the first person ("I", "we", etc.) must be avoided.

Authors should consult the accompanying information letter or the conference organisers to determine whether the paper is required in either camera-ready copy or electronic format. Particular attention should then be paid to the following guidelines:

**For camera-ready copy:** The name of the author and page number must be written on the reverse of every sheet, using light blue pencil.

Sheets must not be folded.

Completed papers should be sent by registered mail or courier service to the address given in the information letter. Ensure that the requested number of copies is enclosed.

**For electronic transmittal:** Files should be in Postscript or PDF format and should be e-mailed to the address given in the information letter. The covering e-mail message should include complete information about the paper including full contact details. Large files should be compressed as zip archives before submission.

Detailed instructions and guidelines for the preparation of PDF and Postscript files are available upon request from the Publisher. Note in particular that for PDF files, only type 1 fonts should be used, to minimise the risk of printing errors.

**TYPING:** Authors should prepare their manuscript in double column format for printing on A4 (8.3in  $\times$  11.7in/210mm  $\times$  297mm) paper, justified if possible,

using Times Roman 10pt typeface, and must ensure that the typing area (centred) matches exactly that shown in the specimen pages.

**FORMAT**: The first page should include (a) Title (10 words is the desired maximum length). (b) Each author's name and affiliation, including present address. (c) Abstract (50–100 words), giving a brief account of the most relevant aspects of the paper. (d) 5–10 keywords taken from the keyword list at the end of this document.

Use single line spacing throughout.

Do not indent the initial lines of paragraphs. Leave a line clear between paragraphs.

Manuscripts should be prepared in the following order: *Introduction* to explain the background work, the practical applications and the nature and purpose of the paper, *Body* to contain the primary message, with clear lines of thought and validation of the techniques described, *Conclusion, Acknowledgements* (when appropriate), *References, Appendices* (when appropriate).

**Section headings** should be centred, in capital letters and numbered consecutively, starting with the *Introduction*. Sub-section headings should be in capital and lower-case *italic* letters, numbered *1.1, 1.2,* etc, and left justified, with second and subsequent lines indented.

All figures and equations to be numbered with Arabic numerals (1,2.....n)

**Tables**: All figures should be numbered with Arabic numerals. Headings should be placed above tables, underlined and centred. Leave one line space between the heading and the table.

Only horizontal lines should be used within a table, to distinguish the column headings from the body of the table.

**Illustrations**: All photographs, schemas, graphs and diagrams are to be referred to as **figures**.

Line drawings should be original and not photocopies.

Lettering and symbols should be clearly defined. Figures should be placed at the top or bottom of a column wherever possible, as close as possible to the first reference to them in the paper. They should be restricted to single-column width unless this would make them illegible.

#### Do not use coloured photographs or figures.

The figure number and caption should be typed below the illustration, left justified, with subsequent lines indented.

Avoid hyphenation at the end of a line.

Symbols denoting vectors and matrices should be indicated in **bold type** or by a wavy underline. *Italic* letters may be indicated by <u>underlining</u> if an italic typeface is not available.

Weights and measures should be expressed in SI units. All non-standard abbreviations or symbols must be defined when first mentioned, or a glossary must be provided.

**Footnotes** should be avoided if possible. Necessary footnotes should be denoted in the text by consecutive superscript numbers. The footnotes should be typed single spaced, and in smaller typesize, at the foot of the column in which they are mentioned, and separated from the main text by a line extending to just over halfway across the column (see specimen pages). Leave a one-line space above and below this line.

**References.** In the text the surname of the author and the year of publication of the reference should be given. Two or more references by the same authors published in the same year should be differentiated by letters a,b,c etc. For references with more than two authors, text citations should be shortened to the first name followed by *et al.* 

Jones (1965, 1968a, b, 1971b) discovered that ...

Recent results (Brown and Carter, 1985; Green *et al.*, 1986) indicate that ...

Only essential references, which are directly referred to in the text, should be included in the reference list.

References must be listed in alphabetical order at the end of the paper. References to the same author(s) should be in chronological order.

**Journal references** should include: author's surname and initials; initials and surnames of remaining authors; year of publication (in brackets); article title (where provided); abbreviated journal title (in *italics*), volume number and page numbers.

**References to books** should include: author's surname and initials; initials and surnames of

remaining authors; year of publication (in brackets); the book title (in *italics*; the name of the publisher and place of publication. References to multi-author works should include after the year of publication: the chapter title (where provided); "In:" followed by book title (in *italics*); initials and name(s) of editors(s) in brackets; volume number and pages; the name of the publisher and place of publication.

References should appear in the following form:

- Abell, B.C. (1945). The examination of cell nuclei. *Biochemical Journal*, **35**, 123–126.
- Abell, B.C. (1956). Nucleic acid content of microsomes. *Nature*, **135**, 7–9.
- Abell, B.C., R.C. Tagg and M. Push (1954). Enzyme catalyzed cellular transaminations In: *Advances in Enzymology* (A.F. Round, Ed.). Vol. 2, pp. 125– 247. Academic Press, New York.
- Baker, R.C. (1963a). *Microscopic Staining Techniques*. Butterworth, London.
- Baker, R.C. (1963b). Methods of preparing thinsection slides. *Journal of the British Medical Association*, **34**, 184–186.
- Charlie, F.H. and M.B. Routh (1966). The chemical determination of toxins. *Journal of the American Chemical Society*, **66**, 267–269.
- Dog, P.R. (1958). In: *Chemical Carcinogenesis* (R.W. Brown, Ed.), Vol. 1, Chap. 7, pp.56–98. Chapman & Hall, London.

**Offprints** can be purchased at a reasonable cost if ordered when the paper is accepted for publication.

**Disposal of scripts**. The original manuscript and diagrams will be discarded one month after publication unless the publisher is requested to return the original manuscript to the author.

**Style file.** IFAC is able to offer a LaTeX style file to authors preparing articles for IFAC Proceedings volumes (see checklist). By using this style, the author can easily format an article (including the bibliography) according to the instructions given to authors by Elsevier Science. The time-consuming check of all typographic details is no longer needed.

**Copyright.** Forms for transfer of copyright will be sent to every author by the IFAC publisher or organizer of the meeting. Any author who does not receive a copyright transfer form should contact the IFAC publisher.

Important: the copyright transfer form must be returned by regular mail, irrespective of whether the paper itself is required in camera-ready or electronic format.

Papers may be omitted from the Preprints (by the Editor) or from the Proceedings (by the Publisher) if they do not conform to the above instructions.

#### SAMPLE PAGES TO BE FOLLOWED EXACTLY IN PREPARING SCRIPTS

## THE TITLE OF THE PAPER, IN BOLD CAPITAL LETTERS, CENTRED, NOT MORE THAN 10 WORDS

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#### Names of the Authors, upper and lower case,

#### boldface, centred, 125 mm (5 in) width

┙

Authors' affiliations, Italics, upper and lower case, centred, 125 mm (5 in) width (maximum)

<u>,</u>,

Keywords: 5–10 keywords (taken from the IFAC list), 125 mm (5 in) width (maximum), left justified.

#### 1. MAIN HEADING, CENTRED, CAPITAL LETTERS<sup>1</sup>

Text of paper, 76 mm (3in) column width, with 8 mm (.3in) space between. Use full 253 mm (10 in) column length. Paragraphs should be justified, using single spacing, with no paragraph indentation. Use Times Roman font, 10 point. Leave one clear line between paragraphs within a section; two clear lines before a main or secondary heading.

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1.1 Secondary Heading, numbered, left justified, following lines indented, Italics or underlined.

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Avoid leaving a heading at the bottom of a column, with the subsequent text starting at the top of the next page/column. Use extra spacings (between earlier figures or sections) to push the heading up to the top of the same column as its text. In view of the tight page constraints, however, do please make the fullest possible use of the text area.

<sup>&</sup>lt;sup>1</sup>Number footnotes consecutively with superscript numbers. Leave a one-line space above and below the footnote line. The character " $\leftarrow$ " is used here to represent a space equivalent to one line of text.



Fig. X. Title of figure, left justified, subsequent text indented. Place figures at the top or bottom of a column wherever possible, as close as possible to the first references to them in the paper. Restrict them to single-column width unless this would make them illegible. Do not use coloured photographs or figures.

Where a **publication** is referred to in the text, enclose the authors' names and the date of publication within the brackets, see (Brown, et al., 1994). For one author, use author's surname and the date (Smith, 1991). For two authors, give both names and the date (Smith and Jones, 1992). For three or more authors, use the first author, plus "et al.", and the date (Morris, et al., 1990a). If giving a list of references, separate them using semi-colons (Brown, et al., 1994; Smith, 1991; Smith, and Jones, 1992; Morris, et al., 1990b).

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Put only the date in brackets when referring to the author(s) of the referenced publication (for example, "This work was first developed by Smith (1991), and later expanded by Brown, et al. (1994), who demonstrated that.....").

Table 1 Heading underlined and centred. Do not use vertical lines within the table; use horizontal lines only to separate headings from table entries

Xxxxx	Xxxxx	Xxxx	Xxxxx	Xxxxxx
				XXXX
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XX	XXX	XX	Х	XX
XXX	Х	Х	XXX	XXX
XXXX	XX		XX	Х
X XX	XXX	XX	XXX	XXXXX

When starting a new paragraph at the top of a column, be careful that the line space before it does not prevent the tops of the two columns from lining up.x xxxxxx xxxxxx xxxxx xxxxx xxxxx xxxxx XXX XXX XXXXX.

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#### Equations are centred and numbered consecutively, from 1

(n)

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#### REFERENCES

List of references arranged alphabetically according to first author, subsequent lines indented. Do not number references. Publications by the same author(s) should be listed in order of year of publication. If there is more than one paper by the same author(s) and with the same date, label them a,b, etc. (Morris et al., 1990a, b). Please note that all references listed here must be directly cited in the body of the text.

- Brown, F., M.G. Harris and A.N. Other (1994). Name of paper. In: Name of book in italics or underlined (Name(s) of editor(s). (Ed)), page numbers. Publisher, Place of publication.
- Smith, S.E. (1991). Name of book in italics or underlined, page or chapter numbers if relevant. Publisher, Place of publication.
- Smith, S.E. and L. Q. Jones (1972). Name of paper. Name of journal in italics or underlined, Volume no in bold, page numbers.
- Morris, K.J., A.C. Davies and J.M. Katz (1990a). XXXX x ixxxxxxx xXXXXXX xXXXXX pp. xx-xxx XXXXXXX. XXXXX, X. X. X.
- Morris, K.J., A.C. Davies and J.M. Katz (1990b), XXXXXXXXXX XX XXX XXXXXXXXXX XXX XXXXXXX XXXXXXXXX XXXXXXX In: XXXXXXX XXXXXXXX XXXX (X.XXXXXXX (Ed.)).XXX.

#### **CHECKLIST FOR THE PREPARATION OF SCRIPTS**

- 10 in× 6.3 in)
- Type area **centred** on the page
- Correct **column length** (253 mm / 10 in)
- $\Box \quad \text{Correct column width } (76 \text{ mm} / 3 \text{ in})$
- $\Box$  Correct inter-column space (8 mm / 0.3 in)

**Type:** Font: Times Roman

- Size: 10 point
  - (for all text, including headings only abstract and footnotes may be smaller)
- **Title**: Bold, upper-case letters
- □ Placing (as sample pages)
- □ Centred
- □ Not more than 10 words
- Authors: Correct placing (2 lines left clear after Title)
- Bold, upper- and lower-case letters
- □ Centred
- □ Affiliations: Placing (2 lines clear after Authors)
- □ Italics
- □ Centred
- □ Abstract: Narrow format (125 mm/5 in)
- Placing (4 lines clear after Affiliations)
- □ Justified
- □ 50–100 words
- **Keywords**: 5–10, from IFAC keyword list
- □ Place (1 line clear after abstract)
- $\Box$  Narrow format (125 mm/5 in)
- □ 4 lines left clear before the start of the main body of the text
- **Paragraphs**: No indentation at start
- □ 1 line left clear between paragraphs
- Main headings: Capital letters
- Numbered
- Centred
- Secondary headings: Upper and lower case
- □ Numbered
- □ Left justified
- □ 2 lines left clear above; 1 below

- Tertiary headings: Upper and lower case
- Run-on text
- Not numbered
- Italics (or underlined)
- 1 line left clear above
- Figures: Acceptable line quality
- Legible text
- Inserted appropriately in the text
- Single-column width if possible
- Figure captions: Below figures
- Left justified
- Subsequent lines indented
- Tables: Headings above
- Headings centred and underlined
- No vertical lines/boxes
- Horizontal lines only to indicate headings
- References: Not numbered
- Alphabetical listing
- Subsequent lines indented
- Correct usage within the text
- All references cited in text
- Language: Spelling checked
- Grammar and use of English checked
- □ Use of "I/we" eliminated

#### **BEFORE SENDING**

- □ Copyright clearance form completed
- Offprint order form completed, if required
- □ Required sending method check instructions

#### Sending by camera-ready copy:

- □ Correct number of copies of manuscript printed
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#### Sending as electronic files:

- □ Manuscript in Postscript or PDF format
- □ Large files zipped
- Delivery e-mail address – check instructions
- Copyright form and offprint order form sent by mail

NOTE: An IFAC style file is available to assist authors working in LaTeX to meet the exact specifications in these instructions. It may be obtained by FTP from the CTAN archives at ftp.tex.ac.uk or ftp.dante.de, in the directory tex-archive/macros/latex/contrib/supported/ifacmtg

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- □ 2 lines left clear above; 1 below

- □ Italics (or underlined)

# automatica

A Journal of **IFAC**, the International Federation of Automatic Control

#### Publication of IFAC Meeting Papers

In announcements for IFAC meetings, the IFAC copyright policy for submitted papers is summarized. It includes the statement:

"Any paper submitted for an IFAC event is automatically considered for publication in Automatica or Control Engineering Practice."

In order to prevent any misinterpretation, a further explanation about the procedures involved in publishing IFAC meeting papers in *Automatica* is given below.

The statement does NOT mean that all papers submitted for IFAC meetings are formally reviewed for possible publication in Automatica. Instead, papers of high quality and general interest are recommended by the meeting organizer and/or editors for further review and evaluation by the Automatica Editorial Staff. Preferably these recommendations are made quickly on the basis of preliminary reviews required to select papers for the meeting programme. Additional recommendations may be obtained from Automatica Editors and Associate Editors later on the basis of the preprinted paper or perhaps the presentation of the paper. Often these recommendations are delayed until after the meeting has been held.

Each recommendation is sent to an *Automatica* Editor, who usually requests the author of the recommended paper to submit a modified, often expanded, version of the paper for possible publication in *Automatica* after further review and evaluation by the *Automatica* Editorial Staff. *The reason for requesting a modified version of the paper is that the criteria for accepting Automatica papers are much different from those used for IFAC meeting papers*. IFAC meeting papers must usually be written in a relatively short time to provide a record of the basic ideas conveyed in the presentation of the paper. Generally, background information, development and computational details, and experimental verification are not included. In addition, the length of meeting papers must be limited to meet the publication constraints of the Preprint or Proceedings in which they are published. *Automatica* papers, however, contain additional background material to greater detail in the development, more depth, more examples, and specific results, if available, to give the papers more of an archival nature. Although the length of *Automatica* papers must also be constraints are not as rigid or severe as are those for meeting papers.

If within three months after the end of the meeting you have not been notified by an *Automatica* Editor that your paper is under review for possible publication in *Automatica*, you may assume that IFAC's copyright has been released.

If you wish to have your paper considered immediately for possible publication in Automatica without waiting for recommendation, and if you believe that it meets the high standards required for Automatica, including a potential archival value, then please do the following:

- a) Modify it to include required background material, adequate detail of the development, more examples, specific results, and especially experimental data, if available. The length of the modified paper must not exceed the maximum length established for *Automatica*, as indicated on the inside back cover of the Journal.
- b) Send six, single column, double spaced copies of your modified paper directly to the *Automatica* Editor who has interests most closely related to the subject of your paper and one copy to the Editor-in-Chief. The addresses and interests of the Editors are listed overleaf for your convenience. Do not include originals of the figures, photographs or biographies. These will be requested at a later date.

Note that if the modified version of your submitted paper does not appear to meet the high standards typical of *Automatica* papers, it may be returned immediately with appropriate comments without being subjected to the formal review procedure. However, without reviews this action is not an irrevocable rejection.

I hope that these notes clarify the Automatica publication policy.

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Professor Huibert Kwakernaak Editor-in-Chief, *Automatica* Faculty of Applied Mathematics University of Twente P.O. Box 217 7500 AE Enschede The Netherlands Tel: +31 53 4893457 Fax: + 31 53 4340733 E-mail: automatica@math.utwente.nl http://www.math.utwente.nl/eic http://www.elsevier.com/locate/automatica

#### Control and Estimation Theory

(in particular optimal and stochastic control, games, state estimation, and discrete event systems)

#### Professor Tamer Başar

Deputy Editor-in-Chief University of Illinois at Urbana-Champaign, Coordinated Science Laboratory 1308 West Main Street, Urbana, IL 61801, U.S.A. Tel: + 1 217 333 3607 Fax: + 1 217 244 1653 E-mail: basar-automatica@decision.csl.uiuc.edu

#### **Control System Applications**

(including robotics, mechatronics, transportation and vehicles, power systems and safety)

#### Professor Mituhiko Araki

Department of Electrical Engineering Kyoto University Yoshida-Honmachi, Sakyoku, Kyoto 606-8501 Japan Tel: + 81 75 753 5333 Fax: + 81 75 753 5332 E-mail: araki@kuee.kyoto-u.ac.jp

#### **Process Control and Computer Control Applications**

#### **Professor Sigurd Skogestad**

Department of Chemical Engineering Norwegian University of Science and Technology N-7034 Trondheim, Norway Tel: + 47 735 94 154/130 Fax: + 47 735 94 080 E-mail: skoge@chembio.ntnu.no

#### System and Control Theory

(including robust control, distributed parameter systems and control system design)

#### Dr Roberto Tempo

CENS-CNR, Politecnico di Torino Corso Duca degli Abruzzi 24, 10129 Torino, Italy Tel: + 39 11 564 7034 Fax: + 39 11 564 7099 E-mail: tempo@polito.it

#### Adaptive and Intelligent Control (including applications, robotics, and new topics such as use of neural networks in this field)

#### **Professor Frank L. Lewis**

Moncrief-O'Donnell Endowed Chair, Automation and Robotics Research Institute, The University of Texas at Arlington, 7300 Jack Newell Blvd. S, Ft. Worth, TX 76118-7115, USA Tel: + 1 817 272 5972 Fax: + 1 818 272 5989 E-mail: flewis@controls.uta.edu/acs

#### **Management and Decision Sciences**

(including large systems, operational research applications of optimization and control, business and management techniques, economic dynamics, environmental modeling, decision support systems, and conflict resolution)

#### Professor Alain B. Haurie

Management Studies (SES-HEC), University of Geneva 102 Carl Vogt, CH-1211 Geneva, Switzerland Tel: + 41 22 705 8132 Fax: + 41 22 705 8104 E-mail: haurie@ibm.unige.ch

#### System Parameter Estimation

(including applications in this field, and new topics such as system fault detection)

#### Professor Torsten Söderström

Systems and Control Group, Uppsala University P.O. Box 27, S-751 03 Uppsala, Sweden Tel: + 46 18 183075 Fax: + 46 18 503611 E-mail: ts@syscon.uu.se

#### Nonlinear Systems and Control

#### Professor Hassan K. Khalil

Department of Electrical Engineering, Michigan State University, East Lansing, MI 48824-1226, USA Tel: +1 517 355 6689 Fax: +1 517 353 1980 E-mail: khalil@ee.msu.edu

#### SPECIAL CATEGORY EDITORS

#### **Survey Papers**

(including all fields in automatic control)

#### **Professor Manfred Morari**

Automatic Control Laboratory, ETH-Zentrum/ETL I 29 CH-8092 Zürich, Switzerland Tel: + 41 1 632 7626 Fax: + 41 1 632 1211 E-mail: morari-automatica@aut.ee.ethz.ch

#### **Rapid Publications**

Technical Communiques and Correspondence (in all fields of control)

#### Professor Paul M.J. Van den Hof

Department of Engineering Physics Delft University of Technology, Lorentzweg 1 2628 CJ Delft, The Netherlands Tel: + 31 15 278 4509 Fax: + 31 15 278 4263 E-mail: vdhof-automatica@tn.tudelft.nl

#### **Book Reviews**

(in all areas of interest related to automatic control)

#### **Professor Rafael Sivan**

Technion, Israel Institute of Technology Department of Electrical Engineering, Haifa 32000 Israel Tel: +972 48 294740 Fax +972 48 323041 E-mail: r.sivan@ee.technion.ac.il

Authors should send six copies of manuscripts for publication to the appropriate Editor. Consult a recent copy of Automatica or the journal home page http://www.elsevier.com/locate/automatica for up-to-date information for authors. Note that submission by e-mail is also possible: details may be found on the journal home page.

#### automatica: Aims and Scope

Automatica publishes papers on original theoretical and experimental research and development in the control of systems, involving all facets of automatic control theory and its applications. Preferably, theoretical papers should include applications; papers dealing with components and systems should include theoretical background and, where appropriate, economic implications.

It is intended to publish only those papers, including those based on IFAC meeting presentations, which may be regarded as new, worthwhile contributions in this field. Papers should be intelligible to the general body of control engineers, which requires that specialized techniques, terminology and acronyms be well defined and/or referenced.

*Automatica* has a tradition of publishing definitive papers covering a topic in depth, papers which are referred to for many years. For such papers the length requirements may be relaxed at the discretion of the Editor-in-Chief.

The scope of the journal is extensive. Topics include: the theory and design of control systems and components, encompassing robust and distributed control using geometric, optimal, stochastic and nonlinear methods, game theory and state estimation; adaptive control, including robotics, neural networks, parameter estimation and system fault detection; additional topics including artificial intelligence, fuzzy and expert systems, hierarchical and man–machine systems, all parts of systems engineering which consider the reliability of components and systems; data processing; and computers for computer-aided design, manufacturing, and control of various industrial processes, space vehicles and aircraft, ships, traffic, biomedical systems, national economies, power systems, agriculture and natural resources.

Submitted articles may be Survey Papers (extensive reviews of established or emerging research topics or application areas), Papers (detailed discussions involving new research, applications or developments), Brief Papers (brief presentations of new technical concepts and developments), Technical Communiqués (new useful ideas and brief pertinent comments of a technical nature), and Correspondence (Letters to the Editor about the journal or to authors commenting on previously published papers. In the latter case, the Editor will give the authors an opportunity to respond). The journal also publishes the following features: Special Issues on the subject of increasing importance, Tutorial Papers, Book Reviews and Software Reviews.

Additional information about *Automatica*, including lists of recently accepted papers and papers under review, a cumulative table of contents (1963–present) and recent and advance editorials, can be found at the Editor-in-Chief's site: http://www.math.utwente.nl/eic.

#### ASPECTS CONSIDERED BY REVIEWERS OF PAPERS FOR AUTOMATICA

Every reviewer of a paper submitted for publication in *Automatica* is asked to respond to the following questions:

- 1. Does the Introduction state the purpose of the paper?
- 2. Is the significance of the paper explained relative to previous work?
- 3. Is the paper clearly written and well organized?
- 4. What is the contribution of the paper?
- 5. How may the paper be improved?

The reviewer is moreover asked to rate the contribution of the paper and its quality, to provide an overall recommendation and to advise in which category the paper should be published.

Finally, the review form provides extensive space for comments to the authors, which are considered very seriously by the editors.

Based on the reviews the Associate Editor prepares a publication recommendation to the Editor who is responsible for the paper.

# **CONTROL ENGINEERING PRACTICE**

A Journal of IFAC, the International Federation of Automatic Control

#### Publication of IFAC Meeting Papers

In announcements for IFAC meetings, the IFAC copyright policy for submitted papers is summarized. It includes the statement:

"Any paper submitted for an IFAC event is automatically considered for publication in Automatica and Control Engineering Practice."

In order to prevent any misinterpretation, a further explanation of the procedures involved in publishing IFAC meeting papers in *Control Engineering Practice* is given below.

The statement does NOT mean that all papers submitted for IFAC meetings will be formally reviewed for possible publication in Control Engineering Practice. Instead, application-oriented papers of high quality and general interest are recommended by meeting organizers and/or Editors for further review and rapid evaluation by the Control Engineering Practice staff. These recommendations are made quickly on the basis of the preliminary reviews required to select papers for the meeting programme. Of course, these recommendations are delayed until after the meeting has been held, and papers which are not presented at the meeting will not be recommended. (However, authors may send meeting papers for possible publication in Control Engineering Practice, either before or after the meeting is held, without a recommendation, using the procedure described below.)

If you wish to have your paper considered individually for possible publication in *Control Engineering Practice*, then please follow the steps outlined below:

- Send 4 copies of the paper to the Editor-in-Chief.
- State clearly in an accompanying letter that the paper has been accepted for/presented at an IFAC event.
- Give the name of the event.

You may also send an *expanded* version of an event paper for consideration: in that case:

- Prepare the expanded manuscript in single-column, double-spaced format ( $L^{A}T_{E}X$  users may use the standard elsart style file).
- Manuscripts should be prepared according to the order: Title, Author(s) name(s), Address(es), Abstract, Keywords, Introduction, Body, Conclusion, Acknowledgements, References, Appendices, Figure captions, Figures, Table captions, Tables.
- Send 4 copies to the Editor-in-Chief.
- Give the name of the IFAC event at which the original is to be/was presented.

Papers accepted for publication will be typeset from authors' disks. However, **please do not send disks** until the technical content has been accepted and the paper has been edited for language. Detailed instructions will be sent to the authors of accepted papers.

Note that if your submitted paper does not appear to meet the standard typical of *Control Engineering Practice* it may be returned immediately with appropriate comments.

I hope these notes will clarify the Control Engineering Practice publication policy.

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#### CONTROL ENGINEERING PRACTICE: Aims and Scope

*Control Engineering Practice* strives to meet the needs of industrial practitioners and industrially related academics and researchers. It publishes papers which illustrate the direct application of control theory and its supporting tools in all possible areas of automation. As a result, the journal contains only papers which can be considered to have made significant contributions to the application of control techniques. It is normally expected that practical results should be included, but where simulation only studies are available, it is necessary to demonstrate that the simulation model is representative of a genuine industrial application.

In addition to purely technical applications papers, the journal carries papers on topics linked to the application of automation, including social effects, cultural aspects, project planning and system design, and economic and management issues.

The scope of *Control Engineering Practice* matches the activities of IFAC, including applications in: aerospace, marine systems, communication systems, biomedical engineering, pulp and paper processing, environmental engineering, scientific instrumentation, transportation and vehicles, power plant and other utilities, mining, mineral and metal processing, chemical and biotechnical process control, manufacturing technology, and production engineering.

The journal covers all applicable technologies, including: robotics, identification, signal processing, project management, autonomous vehicles, computer networking, modelling and simulation, human computer systems, components and instruments, adaptive and robust control, electromechanical components, model-based control techniques, fault detection and diagnostics, software engineering techniques, hydraulic and pneumatic components, real-time and distributed computing, intelligent components and instruments, architectures and algorithms for control, computer-aided systems analysis and design, software design, software verification and safety, and artificial intelligence techniques, including fuzzy control, neural networks and genetic algorithms.

#### ASPECTS CONSIDERED BY REVIEWERS OF PAPERS FOR CEP

The questions listed below appear on the *CEP* Review Form, and are considered by the reviewers and editor when assessing papers for possible publication. Authors may, therefore, find it useful to bear them in mind when preparing papers for submission.

- 1. Is there an immediate "appeal" to a practising industrial engineer? Is the title explicit, attractive and interesting? Is the abstract clear and to the point, stressing both the specific application and the generic aspects of the work?
- 2. Does the Introduction clearly state the field of application ?
- 3. Is there real evidence of the practical industrial benefits of the technologies/methods introduced, e.g. where they were applied, and what improvements resulted? Does the Conclusion state these clearly? Work using simulations should have been properly validated for a real process. (Papers which are purely theoretical will be sent back to the authors after the preliminary assessment, and without further review.)
- 4. Are there generic aspects which make the work applicable beyond a narrow range of applications? Are these clearly brought out in the paper, so as to broaden its readership?
- 5. Is the paper correct technically?
- 6. Is there some aspect, in either theory or application, which is new or innovative?
- 7. Is the paper intelligible, but non-trivial, to a practising professional engineer in the field of intended application?
- 8. Is the paper intelligible, and of some relevance to, practising professional engineers in other fields?
- 9. Is the paper easy to read, i.e.
  - Is it to the point?
  - Is it grammatically and semantically simple and correct?
  - Are the figures, graphs, etc., clear, explicit and properly labelled?
  - Are the mathematics essential? Enough detail should be given so that numerical examples can be reproduced exactly, but mathematical proofs should be referenced, rather than spelt out in tedious detail.
  - Are the references complete, and relatively easy to obtain?
  - Is the length appropriate? Most papers will tend to be between 5 and 10 pages in length (final journal article), but shorter or longer papers are acceptable *if* their lengths are appropriate to their contents.
- 10. Survey/review papers should be authoritative and of high quality.
- 11. Finally,

Would the paper justify the time spent by a busy person in reading it? Would the reviewer, or reader, learn something from it?

#### IFAC KEYWORD LIST OF CONTROL TERMINOLOGY

### **A** Absolute

Absolute error criterion measurement stability AC conductivity converter machines losses wires machines tacho generators Accelerometers Access times Accuracy Active brake control compensation control elements filters narrow band suspension noise control vehicle suspension Actuating signals Actuators Ada tasking programs Adaptation Adaptive algorithms arravs control correlation digital filters equalization equalizers filters systems A/D converters Add-subtract time Adders Address registers spaces Addressable location addressing Addresses Adjacency Adjustment Admittance Aerospace computer control control engineering trajectories Affine Agents Agile control manufacturing Agriculture Air pollution traffic control Aircraft control operations Alarm systems Algebraic approaches Riccati equations selection systems theory Algorithmic languages Algorithms All pass elements filters Alternating magnetic fields Ambient noise Amplidyne Amplification Amplifiers Amplifier systems Amplifying elements Amplitude

distortion locus modulation response Analog computer control computers control multipliers signals/digital converters Analysis of variance Analytic approximations AND elements operations Angular acceleration deviation frequency momentun position velocity Antennas Antilock braking systems Antiskid control devices Anti-spin regulation Anti-wheelspin control Applied neural control Approximate analysis Arc resistance Architectures Arithmetic algorithms and logic units Arm movements singularities ARMA models parameter estimation Armatures Array filters processors Artificial intelligence Assemblers Assembly language robots Astatic control Asymptotic analysis approximation properties stability Asynchronous sequential logic Attenuation correction observations Attenuators Attitude algorithms control gyros Attractors Authentication Auto correlation functions Automata theory Automated guided vehicles Automatic control (closed-loop) engineering (open-loop) systems controllers frequency control gain control operation people models process control

(closed-loop) (open-loop) recognition regulators restart sequence control testing Automation Automobile industry Automobiles Automorphism Automotive control emissions Autonomous control mobile robots vehicles Autoregressive models Autotransductors Autotuners Availability Available time Average values Averaging control

### B

Backlash Backpropagation algorithms Backtracking Back-up controllers svstems Bad data identification Bandpass filters Bandwidth allocation voice networks coaxial probes electrical pulses measurements minimization problems Bang-bang control Bank switching Banyan networks Batch control modes Baud rates Bearings only tracking Behaviour Behavioural science Benchmark examples Bessel functions Bias winding Bilinear control systems transformations Binary arrays coded decimal codes control decision systems elements images logic systems search trees signals storage elements tree architectures trees Binding Bio control Biocybernetics Biomedical control svstems Bionics Biotechnology

Bispectrum estimation Bistability devices Bistable multivibrators Bistable trigger elements Blackboard architectures Block diagrams Blow moulding Bode diagrams Boilers Bolometers Bond graphs Boolean algebra functions logic operations Boundary conditions detection element method integral formulation value problem Bounded disturbances noise Bounding method Brain models Brakes Branches Breadth-first searches Breakpoints Bridges Brownian motion Brushless motors **Bubbles** Buffer amplifiers storage Bugs Business process engineering Bus multiprocess or systems Butterworth filter Bypass clutch control

### C

Cables Cableway systems Cache coherence protocols memories Caches CAD/CAM models Calculators Calculus Calibration CAM Cameras Cancellation Capacitance Capacitive compensation Capacitively loaded iunctions Capacitor filters Capacitors Capacity Cartesian manipulators products Cascade compensation control exciters CASE Catastrophe theory Categorical data Cathode follower ray tubes

CD ROM Cellular automation logic neural networks Central processing units processors Centralised control Centre of mass Centrifugal governors Certainty Chaos theory Chaotic behaviour Character recognition Characteristic curves equation impedance polynomials roots time vector Characters Charge amplifiers Chassis control dynamometers Chattering Cheap control Checkpointing Checkpoints Checksums Check valves Chemical industry microsensors sensors variables control Cholesky factorization Chopper amplifiers Circuit models performance simulation switched networks Circuits Classification Classifiers Clocking Clocks Clock synchronization Closed-loop control controllers gain identification phase angles systems transfer functions Closed loops Closed queuing networks CMAC CNC Coarse-fine control relays switches Code converters Coded modulation Coders Coding schemes Coefficient of stability perturbation Cognitive science systems Coils Coloured noise Combinational circuits networks Combinatorial

circuits

mathematics switching Command and control systems control signals variables Communication channels control applications environments networks protocols systems Communications systems Compact spectra Companion matrices Comparators Comparing elements Compatibility Compensating elements feedback feedforward winding Compensation Compensators Compiler optimizations Compilers Complementarity problems Complementary codefeedback formulations functions Complements Complete controllability Complex perturbation planes systems variables Components Compound actions controllers semiconductors Compounding feedback feedforward Compressors Computational methods Computed torque control Computer -aided circuit design control system design design diagnosis engineering instruction manufacturing system design testing work applications architectures communication networks control controlled systems experiments graphics hardware -integrated enterprises manufacturing interfaces networks programming programs recreations simulation software subroutines systems tomography vision Computers Computing

elements linkages systems Concentrators Conceptual representations Concurrency control Concurrent architectures engineering programs searches systems Condition numbers Conditional probability . stability Conductivity Conductors Configuration control management space stability Conformal mapping techniques Conjugate gradient method points roots Conjunction Connected parallel computers Connectionism Connections Connective instability stability Connectivity Consistency Consoles Constant of inertia Constrained parameters poles Constraints Constraint satisfaction problems Contact resistance Continued fraction expansions Continuity Continuous action controllers controlpath control phase modulation speech recognition systems time filters time systems variables Continuously variable transmission Control accuracy actions algorithms applications circuits (closed-loop) education engineering applications of computers equations equipment errors functions instants laws loops nonlinearities (open-loop) oriented models panels points precision ranges schemes

analysis design synthesis systems technology theory units valves windings Controllability Controlled conditions devices systems variables Controller modulators vehicles Controllers Controlling elements machines power stations Conventional control Convergence analysis factors of numerical methods proofs Convergent control series Conversion Converters Convex optimisation programming projections Convolution integral Co-operation Co-operative control Co-ordinate time transformations Co-ordinates Co-ordination Co-ordinator Coprime factorization Coprocessor Copy Copyright Corner frequencies Corona discharges Coronas Corporate strategies Correcting conditions feedback feedforward ranges variables Correction times Corrective actions Correlation coefficients Cosine transforms Coulomb damping friction Counters Coupled devices mode analysis mode theory Coupling coefficients functions losses models Covariance matrices Criterion functions Critical areas current density damping path analysis points . state models

stations

system

Cross correlation functions Crossover frequency Cross-phase modulation Crosstalk interference Cruise control Cryogenic temperatures Cultural aspects of automation Current amplifierscomparators decay densities distributions gains losses regulators transformers voltage characteristics Cursors Curves Cut-off frequencies rates Cybernetics Cycle length D

# **D**<sub>D/A converters</sub>

Damage Dampers Damping coefficients constants factors ratios Dashpots Data acquisition compression compression algorithms flow analysis flow diagrams flows fusion handling systems hold loggers logging models privacy processing processors recorders reduction replication sets storage streams symbols transmission Database management systems structures systems Databases Dead band Dead-beat control Deadlines Deadlock Dead zones Debugging Decay Decentralized control systems Decision block decoders circuits feedback equalization fusion making support systems tables theory

trees Decoders Decomposable searching problems Decomposition methods theorems Deconvolution Decoupled subsystems Decoupling precompensators problems zeros Decrepitation Definite corrective action Degenerative feedback Delay analysis circuits compensation demodulation elements estimation lines spread modulation Delivery systems Demodulators Density measurements Derivative action elements Describing functions Descriptor systems Desensitization Design systems . VLSI Detecting elements Detection algorithms systems Detector performance saturation Detectors Determinism Deterministic behaviour systems Device degradation simulation simulators Developing countries Diagnosis Diagnostic inference programs tests Diagonal dominance Diagrams Dialogue Diaphragm actuators valves Diaphragms Diesel engines Difference amplifiers analysis equations Differential analyzers detection equations field rotors gain games gaps gears geometric methods geometry relays transformers Differentiating actions elements Differentiators Digital

circuits communications computer applications computers control conversion techniques converters differential analysers filter processors filter structures filters images mobile radios patterns radios signal processors signals simulation systems VTR Digitisers Diluted magnetic semiconductors Dimensional systems transfer functions Dirac functions Direct digital control -drive robots dynamic problem Fourier reconstruction frequency modulation kinematic problem overwrite Directed graphs Discontinuities Discontinuous action control Discrete cosine transform digital dynamic control -event dynamic systems -event systems Fourier transforms measurements systems time time detection -time systems Discretization Discriminant analysis Discrimination Discriminators Disk memory Disks Displacement cascades transducers Displays Distance transformations velocity lag Distillation columns Distributed amplifiers artificial intelligence computer control systems controldatabases detection feedback models non-linear elements parameters -parameter systems simulation Distribution automation control feeders networks readout systems systems Distributions Disturbance localization parameters rejection

signals variables District heating Disturbance rejection Dither Dividers Division Documentation Documents Domain analysis Domains Dominant points roots Drag cup motors DRAM Drawings Drift rate velocity Driver behaviour models Drivers Drives Driving voltage Drum memory Dry friction Dual composition control Dual-computer systems Dual-mode control Duality Duplex control Duty cycles factors Dynamic behaviour bias control channel assignment decoupling degradation modelling models output feedback programming properties range stability systems tests Dynamics

### E

Dynamometers

Ecology Economic design systems Economics Eddy current analysis problems . techniques currents Education Educational aids Effect device power Effect devices Effect transistor structures Effective bandwidth channel length cut-off wavelength deadtime mass range Efficiency enhancement Efficient algorithms evaluation Eigenfunction Eigenmode analysis Eigenstructure assignment Eigenvalue assignment

lower bounds placement problems Eigenvalues Eigenvectors Electric field sensors fields machines power systems throttle control vehicles Electrical activity appliances behaviour breakdown characteristics conduction conductivity contacts feedback impedance machines networks properties pulses shocks stimulation Electro-hydraulic systems Electrodes Electromagnetic devices field problems fields induction modes pulses scattering problems signals transducers transients transmission waves Electronic applications control units (ECU) mail systems Electronically-controlled transmissions Electronics Element analysis Embedded systems Encoders Encoding End point control End users Energy control dependence distribution expenditure management systems spectra storage weighted acquisition Engine control dynamometer efficiency management modelling systems Enhancement Enterprise integration modelling Enthalpy relaxation Entropy Envelopes Environmental coefficients stability Environment architectures control Environmental engineering Environments EPROM

Equalization Equilibrium Equipment Ergonomics Error analysis control -correcting codes correction criteria -detecting codes detection estimation -free probability rate performance rates transfer functions Estimation algorithms parameters theory Estimators Ethernet Evaluation Events Excitation control windings Execution times Exhaust gas recirculation Expanded memory Expert systems Exponential lag Exponentiality Exponentially stable Extended Kalman filters Extended networks Extrusion

### F

Factorization methods Factory automation Failure detection isolation Farming Fast Fourier transforms Kalman algorithms parallel algorithms timing methods Fatigue Fault detection diagnosis distributions identification isolation location tolerance -tolerant software -tolerant systems Feedback amplifiers capacity channel control methods elements lasers linearization loops signals stabilization systems variables Feedforward compensation control networks Fermentation processes Fibre amplifiers conduction velocity connectors couplers

interferometers networks optic gyros networks sensing thermometry preamplifiers Field effect transistors Field effects Fieldbus Filter hanks circuits design stability Filtering problems techniques theory Final controlling drives value theorem values Finance Financial systems Finite arc segments automata difference method solutions differences element analysis computation field simulation method solutions elements fields state machines First-order systems Fixed command control Flapper valves Flexible arms automation manufacturing systems Flicker Flight control Flip-flops Floating action control Floppy disks Flow control diagrams heterogeneity measurement Flowcharts Fluctuations Flux densitv space vectors Follow-up control Food processing Force balance control Forced oscillation Forecasts Formal languages methods specification verification Formats FORTRAN Forward channels control elements paths . signals Four-wheel drive steering Fourier

analysis optics transforms Fourth-generation languages Fractal systems Fractals Fractional harmonics Fractions Frame synchronization Frequencies Frequency changers control conversion -dependent characteristics dispersion dividers domains estimation measurements modulation -response characteristics methods responses signal analysis spectrum stabilization standards tracking Friction Front end Fuel control injection Full graphic displays wave analysis wave discontinuities waves Function approximation generators Functional blocks chains Fundamental constants matrices processes relations Fuzzification Fuzziness Fuzzy control data expert systems hvbrid systems inference inputs logic modelling models outputs sensors sets -set theory subsets supervision systems

#### G

Gain characteristics crossover frequency cut-off frequency dynamics enhancement methods margins modulation regimes saturation suppression Game theory Gap electrical machines elements measurements

transient torques Garbage Gas insulated substations switchgear turbines Gauss Markov sources Gaussian distributions functions noise processes General bilinear transformations nonperiodic waves simulators Generalized connection networks linear systems modus ponens predictive control quantizers sidelobe cancellers state space Generated Lyapunov functions Generation lifetime Generator Generators, electric Genetic algorithms Geometric approaches codes distributions properties Geometrical theory Geometry Gimbal axes Gimbals Global optimization positioning systems stability Gradient methods Gradients Gradiometers Graph theoretic models Graph theory Graphic displays printers Graphs Green/Es function Group work Guidance systems Gyromagnetic ratios Gyros Gyroscopes

### Η

Hall effect elements Hand-printed characters Handling Hardware Harmonic analysis balance analysis techniques drives functions generation response characteristics responses Harmonics Hashing Headers Heart wall motions Heat exchangers flows Helicopter control dynamics

Heuristic programming searches Heuristics Hierarchical control decision making structures systems Hierarchically intelligent control Hierarchies High current density -density -efficiency -frequency diffraction noise performance -gain feedback -temperature stability superconductors Higher-order statistics Hilbert spaces transformers Hill climbing H-infinity control optimization Histograms Holding actions elements voltages Holography Huffman codes Human brain -centered design error factors -machine interface perception reliability supervisory control Hurwitz criterion polynomial HVDC transmission lines Hvbrid computers modes vehicles Hydraulic accumulators actuators amplifiers motors relays turbines Hydroelectric systems Hydrogenerators Hydrothermal power systems Hyperstability Hypertension Hypotheses Hysteresis error loops losses motors Ι

Ideal values Identifiability Identification algorithms Identifiers Idle speed control IF-THEN operators Image amplification analysis coding

compression converters distortion enhancement flows intensifiers interpolation matching modelling motion compensation processing recognition reconstruction registration restoration segmentation sensors smoothing Imaginary axis Impact Impedance control Implementation Implication operators Implicit systems Impulse conditions functions responses signals Impulses Incomplete data Index method profiles Indexes Indicated angles Indices Indicial responses Indirectly controlled systems variables Induced efficiency enhancement instability Inductances Induction generators machines motor design motors Inductive pickoff Inductors Industrial control production systems robots Industry automation Inertia matrices Inertial measurement units navigation platform reference units sensors Inference engines processes Infinity control Information analysis capacity depth flows integration retrieval systems technology theory Infrared detectors Inherent feedback stability Inheritance Initial characterization states Injection moulding Inner

loops matrices Innovation Input admittance centralised systems decentralised systems elements equipment estimation impedance matrices signals Inputs Insensitive Insensitivity Instability Insulation Insulators Insulin sensitivity Integer programming Integral action factors rates times actions control controllers cross sections equation formulations equations formulation performance indices representations Integrals Integrated circuit antennas yields circuits injection logic optics plant control vehicle highway systems (IVHS) Integrating amplifiers elements gyros Integration Integrators Intelligence Intelligent control cruise control instrumentation knowledge-based systems machines manufacturing systems Intensity changes modulation method noise Interacting queues service stations Interaction mechanisms Interactive approaches programs vehicle control vehicle dynamics Interactor matrices Interchangeable terminals Interconnected systems Interconnection matrices networks technology Interdigital transducers Interdisciplinary design Interface state generation states Interfaces Interference Interleaved memory Interlocking

Intermittent signals Internal combustion engines topology International stability surveys Interplanetary spacecraft Interpolation algorithms approximation Interpretation trees Interpreters Intervals Intrinsic bistability modes Invariance Invariant systems Invariants Inventory control Inverse dynamic problem dynamics control kinematic problem Monte Carlo Nyquist array scattering problem system transfer function locus transform Inversion Inverter drives Inverters ISDN ISO Isolated networks Iterative improvement methods

### J

Jacobian matrices JIT manufacturing Jitter Joint probability trajectories Jordan canonical form normal form Jump process Junctions

### Κ

Kalman filters Kharitonov theorem Kinematics Kinetic control system Knowledge acquisition -based control -based systems engineering representation toolstransfer

### L

Labels Laboratory education techniques Ladder algorithms filters Lag elements

networks Laplace transforms Large AC motors cassegrain antennas deviations -scale systems signals space structures Largest singular value Lattice filters Lattices Lead networks Leads Leakage current reduction currents properties Lean manufacturing Learning algorithms control systems Least squares Least-squares approximation algorithm estimation identification method problems Level control Levels Life cycles Lifetime Light Likelihood function Limit cycles theorems Limited codes data Limiters Limiting control actions distributions Limits Linear analysis block codes codes control systems dependence differential transformers equations estimation filters independence integrated optics motors multivariable systems networks optimal control regulators output feedback phase , prediction programming quadratic regulators systems theorv Linearizable systems Linearization Linguistic support synthesis variables Living systems LMS algorithm Load dispatching flows

flow solutions forecasting frequency control modelling regulation

Local area networks computer systems control controllability structures Locus Logarithmic time dependence Logging Logic analysers applications arrays circuits controllers design diagrams gates minimization units Logical control operation products sums Long-term memory Loop gain phase angles transfer Loops Loss minimization Losses Low drive power energy frequencies -frequency dispersion -frequency intensity -frequency noise -frequency scattering -level languages noise -noise channels -noise optimization pressure threshold -threshold current Lowpass filters LQG control method LQR control method LSI chips Lubricants Lumped constant models Lumped-parameter systems Lyapunov equation function methods stability

### Μ

Machine code languages learning -oriented languages recognition Machinery Machines Machining Macro Magnetic amplifiers bearings brakes clutches dipole excitation field computation fields fluid clutches modulators powder clutches , properties recording channels

resonance microscopy responses superlattices suspension Magnetically insulated gaps Magnetization reversal Magnetized ferrite Magnitude contour Main memory database systems (MMDBS) Maintenance engineering Man/machine interaction interfaces systems Management svstems Manipulated variables Manipulation tasks Manipulator inertia matrices Manipulators Manoeuvrability Manoeuvring target Manual control operations Manufacturing processes systems Many-degrees-of-freedom systems Marginal distribution stability Marine systems Markov decision problems decision processes models parameters Mass spectrometry Master-slave systems Matched filters Material balance control systems Mathematical models programming systems theory Matrix algebra determinants elements equations formulation inversion methods polynomial equations printers . Riccati equations triangularization Maximum entropy likelihood estimators principle Maxwell equations MC machine tools Mean -square error time between failures (MTBF) to failure (MTTF) to repair (MTTR) value analysis Measured feedback values Measurement noise Measuring elements points range span

transducers transmitters units Mechanical engineering manipulators properties stress systems Mechanisms Mechanization Medical systems Median filters frequency Medical applications Membership degrees functions Memory applications banks cellinterference junction cells units Memoryless sources Mental workload Meta-level knowledge Metadyne generators Metals Method of weighted residuals Methodology Metrics Microcomputer -based control -based systems systems Microcomputers Microprocessor control Microprocessors Microprogramming Microscopes Microstrips Microsystems MIMO Minimax techniques Minimization Minimum distance -phase systems principle redundancy -time control variance control Minor loops Missiles Mixed sensitivity problem Mobile robots Modal control couplers transformation Mode analysis structure theory Model approximation -based control -based recognition -following control management reduction reference adaptive control control Modelling errors Models Modems Modes Modulation Moment method Moments of inertia Monitored control systems

Monitoring elements feedback loops Monitors Monopolar Monostable multivibrators trigger elements Monotone systems Monotonicity Monte Carlo calculation method simulation Motion estimation parameters Motor control elements patterns units Motors Mouse Movement Moving average models objects Multi-access systems Multi-action controllers Multi-input/multi-output systems Multicache Multichannel controllers Multichip Multicomputer systems Multiconductor systems transmission lines Multidimensional digital filters systems Multilevel codescontrol controllers structures svstems Multiloop control Multimachine Multimedia Multiobjective optimisations Multiple-criterion optimisation Multiplicative noise Multipliers Multiport networks Multiposition controllers Multiprocessing systems Multiprocess or systems Multiprocessors Multiprogramming Multirate Multisensor integration Multispeed controllers floating action Multistep avalanche chamber controllers Multitarget tracking Multivalued mapping Multivariable control systems feedback control systems polynomials systems Multivariate quality control Multiversion software Multivibrator

N NAND elements operations Nash games Natural frequencies languages line widths Navigation systems Negative feedback transconductance Network analysers observability reliability topologies Networks Neural activity control dynamics -network models nets networks Neutral steer zone control zones Nichols charts diagrams Noise analysis characteristics characterization control levels power spectrum Noisv channels images speech Non-Gaussian processes Non-interacting control Nonlinear analysis circuits control systems distortion equations external cavity filters gain interfaces mirrors models optical interactions Poisson equation potentiometers programming refraction refractive indices systems theory Nonlinearity Non-minimum phase systems Non-orthogonal problems Non-parametric identification regression Non-polar liquids Non-sinusoidal waves Non-stabilizable systems Non-stationary learning characteristics signals systems Non-symmetric linear systems NOR elements operations Normal distribution Norms

NOT elements Notch filters Nozzles Nuclear plants power stations reactors Number systems Numeric control Numerical algorithms analysis methods simulation solutions Nyquist diagrams filters Nyquist's criterion

#### O Object

modelling techniques -oriented programming recognition Objects Observability indices Observable Observers Obstacle avoidance detection Obstacles Off-line programming Office automation Offset voltages Ohmic contacts Ohms On-line closed loops control security analysis On-off actions control controllers Open -loop control systems transfer functions loops structure mixers Opening switches Operability Operating systems Operational amplifiers calculus characteristics Operations research Operators Optical amplifiers band gap birefringence bistability character recognition communication constants data storage directional couplers disks feedback fibre networks fibres fields flows , implementation modulation modulators nonlinearities parametric oscillators polarization bistability properties

pulses . receivers response solutions spectroscopy stochastic control storage devices switches transducers transmission wave breaking Optimal control estimation experiment design filtering load flow power flow priority assignment regulators rejection search techniques systems trajectory Optimality Optimization devices problems Optimum Order reduction Organizational factors OR operations Oscillation Oscillators Outages Outer gimbals loop Output axis brushes error identification feedback injection matrices regulation signals variables winding Overall stability Overdamping Overflow Overlaid Overlap Overlapping Overload Overshoot Oversteer Overtones Overvoltages Overwrite spectra Р Package design Packages Packets Page printers Paper industry Parallel algorithms computation

computers

memories

networks

processing

processors

programs

Parallelism

Parameter

Parameters

Parametric

transductors

estimation

identification

optimization

excitation

resonances

variation

Parametrization Parsers Partial differential equations expansions response channels Particle size measurement Particulate processing Passive compensation elements filters ranging suspension Passwords Path planning Pattern generation identification recognition Pay-off functions P controllers PD controllers Performance analysis characteristics drives evaluation functions indices limits monitoring Periodic motion replacement structures waves Permalloy films Permanent magnet motors undulators Permanent magnets Permeability Permittivity Permutation algorithms Perturbation analysis theory Perturbed coefficients Personnel qualifications Petri-nets Pharmacokinetic data Phase advance controllers network angles calibration centres characteristics conjugation contours correction crossover frequency difference distortion epitaxy frame analysis inverters lag lead -locked arrays -locked loop locking locus margins modulation noise -only modulation perturbation technique plane response shift shifters space stability system identification systems

transition Phased array pH control Photodiodes Photomultipliers Photons Physical models Physics Physiological models Physiology Pick off PI controllers Picture elements processing PÍD control controllers Piecewise linear analysis controllers Pipelined architectures VLSI Pipelines Pipelining processing Piston valves Pistons Pitch Pitchfork bifurcation Pixels Plane wave exposure Plane waves Planning Plants Plantwide Plastics industry Pneumatic relays systems Point-to-point control Pointing systems Poisson arrivals processes Polar plots Polarity Polarization analysis dependence Pole assignment zero assignment Poles Polygons Polymerization Polynomial methods modelstransforms Polynomials Polyphase networks Popov criterion Port fuel injection Posed problems Position accuracy control errors estimation feedback location -sensitive photomultipliers velocity Positioning systems Positive columns displacement pumps feedback Possibility theory Postmortems Potentials Potentiometer pick off Potentiometers Power amplifiers assisted control controlcircuits density spectrum deposition

characterization devices dissipation distribution distribution circuits dividers flow generation law descriptions losses management spectra spectral densitv station control supplies supply voltages -system control stabilizers voltages systems transformers transmission winding Preamplifiers Precision measurements Prediction error methods intervals methods problems Predictive control Predictor theory Pre-excitation Preprocessing Preprocessors Preset Pressure control measurements -sensitive probes transducers volume relationships wire chambers Pressurized water reactors Prevention Preventive maintenance Primal sketches Primary regulation sites Principle of superposition Printed antennas circuit antennas circuits dipoles Printers Printing industry Prior history Priority Probabilistic data association load flows logic models risk assessment simulation Probabilities integration Probability density function distribution function Probes Problem solvers Problem-oriented languages Procedure-oriented languages Process automation computers control -control languages equipment identification models parameter estimation simulators Processes

Processing techniques

Processor arrays systems Processors Product strategy Product quality Production control costs systems Productivity Products industry Profiles Program assemblers controllers controlling elements costs diagnostics documentation stores Programmable controllers logic controllers read only memory (PROM) Programmed control Programming approaches environments languages support systems theory Programs Project management selection Projects Propagation Proportional action factor actions bands control factors controllers counters gain plus derivative action controllers plus integral action controllers plus derivative action plus derivative controllers Propulsion control Protection Protocols Prototyping Pseudo random sequences Pulp industry Pulse generation position modulation radiation response sequences shape synthesis signals (train) functions trains width -width modulation Pulses Q

Quadratic control optimal regulators performance indices programming stability stabilizability Ouadrature axis brushes detection

mirror filters Qualitative analysis control simulation Ouality control of work life Quantity Quantization errors noise Quantized signals states Quantizer design Quantizers Quaternion feedback Queues Queuing network models theory

### R

Radial base function networks pumps Rail traffic Railways RAM Ramp function response functions input Random access memory (RAM) drift fields functions inspection . media noise number generators numbers perturbations processes searches telegraph noise variables walk Range data finders images of disturbance of set value splitting Ranges Ranks Rapid programming Rate actions constants feedback Rational matrices Ratios Re-energization Reachability Reachable states Reactive power Reactor control modeling Readouts Real axis time -time AI communication computers computer systems expert systems languages operating systems svstems tasks Realisation theory

Reasoning Receivers Reception Receptors Recognition Recording channels codes heads media noise performances properties technology Recordings Recovery circuits times Recruitment modulation Rectangles Rectangular wave transforms waveguides waves Rectifiers Recursive algorithms approaches control algorithms digital filters estimation filters least squares Reduced-order models Reduction Redundancy control reduction Redundant manipulators Reference adaptive control architecture elements input elements signals variables signals variables windings Regeneration Regenerative feedback Regions Register allocation Registers Registration Regression algorithm systems analysis estimates relationships Regularization Regulating elements energy units Regulation Regulator control theory Regulators Rejection Relational databases Relative stability Relativistic Relaxation analysis oscillation frequency Relay control Relays Reliability analysis evaluation test systems theory Reliable Relief valves Remote control

Renewable energy systems Renewal processes Reproducibility Reproducible Requirements analysis Reserves Reset actions times Residue feedback number systems Residues Resistance Resistivity Resistors Resolution Resolved gain measurements reflectance Resolvent matrices Resonance Resonant frequencies Resource allocation Response curves functions measurement times Responses Restricted instruction sets Return difference ratio differences signals Reversibility Reversible systems Revolutions Riccati equations Ride comfort Rise time Risk RNA Road traffic Robot arms calibration control dynamics kinematics navigation programming vision Robotic manipulators Robotics Robots Robust control estimation estimators performance stability stabilizability transmission Robustness Root locus diagrams Root mean square value Roots Rotating disks Rotation Rotor generators Rotors Round-off noises Routh's criterion Routing algorithms Rule-based systems Rules Run-timesystems Runge-Kutta method

### S

Safety analysis -critical Sample

and hold sizes Sampled data -data control -data systems signals Samplers Samples Sampling actions control controllers elements frequency intervals periods rates systems Satellite control applications Satellites artificial Saturation controlpower Scalar Scales Scattered data Scatterers Scattering parameters problems Scene analysis segmentation Scheduling algorithms Search engines methods Searches Searching systems Second-order systems Self -adapting algorithms -adaptive control -adjusting systems -aligned structures excitation winding -excited oscillation -operated control -optimizing control -optimizing systems -organizing storage -organizing systems oscillation phase . -phase modulation -regulation -reproducing automata -tuning control -tuning regulators Semantic networks Semi -active dampers suspension -empirical models -Markov processes Sensitive Sensitivity analysis functions Sensor failures fusion systems Sensors Sequence estimation Sequences Sequential control algorithms machines switching Series compensation resistance

transductors

Servo hydraulics systems Servomechanisms Servomotor actuators Servomotors Set -point control points -reset operations values Sets Settling times Shape description discrimination Shaped reflectors Shapes Shaping filters . networks Shift registers Ship control Shop-floor oriented systems Short-term memory Shunt capacitors compensation Sign detection Signal analysis cancellation converters correlation delav detection duration flow diagram levels lines processing processing algorithms processors reconstruction selectors space codes synthesis -to-noise ratio Signals Signature analysis registers Simulation languages Simulators Simultaneous stabilization Sine -cosine potentiometer waves Single -input/single-output systems mode -mode operation Singular control perturbation method perturbations points systems value decomposition Singularities Sinusoidal oscillators signals Sinusoids SISO Skill -based production -based systems Slave stations Slaves Sliding curves mode -mode control surfaces Slopes Slot

assignment algorithms lines Slots Small signal modes Smart power applications Smoothing filters Smoothness criterion Social and behavioural sciences impact of automation requirements Socio-technical system design Soft sensing Software engineering metrics performance productivity project management reliability safety specification tools Solar cells energy Solid state cells lasers Solids processing Space robotics vehicle optical-controlsstructure interaction (O-CSI) vehicles Spacecraft autonomy Spark advance control Special-purpose computers Spectra Spectral analysis characteristics correlation density function estimation factorization transformations Spectroscopy Spectrum analysers analysis estimation filters Speech . analysis control Speed control measurement Splines Split field motors series motors Springs SOL Square waves Squaring circuits Stability analysis criteria domains limits of numerical methods properties robustness tests Stabilizability Stabilization methods Stabilizers Stabilizing controllers feedback feedforward networks Stable

states Stackelberg games Standalone Standard Standards Star networks State assignment estimation feedback matrices monitoring observers scintillation detectors sequence estimation space -space formulas -space methods -space models -space realization trajectories variables vectors Statecharts Statements States Static accuracy controllers decoupling electrification friction induction transistors models RAM Stationarity Statistical analysis design inference process control Statistics Stator windings Status reports Steady-state availability deviation errors stability values Steady states Steam generators plants . turbines Steel industry manufacture Steepest descent Step discontinuity function responses functions inputs motors Stepless actions Stepping actions controllers motors relays switches Steps Stereo vision Stochastic approximation automaton complexity control jump processes modelling parameters Petri-nets programming properties realization relaxation systems theory variables

Stop band filters Strapdown systems Stray capacitance fields losses magnetic fields Stress Structural constraints optimization parameters properties relaxation stability Structure systems Structured analysis programming singular value Suboptimal control systems Subspace methods Substitution Subsynchronous oscillations resonance Subsystems Successive approximations technique Summing amplifiers elements points Supercomputers Supervision Supervisory control Susceptibility Switched capacitor filters capacitors reluctance motors Switches Switching algebra algorithms characteristics functions networks rectifiers surfaces theory times values variables Symbols Synchro angles control receivers control transformers control transmitters indicators resolvers torque receivers torque transmitters transmitters Synchronization Synchronous data flow machines motorsSystem analysis architectures diagnosis documentation failure and recovery failures identification integration integrity matrices models noise order reduction reliability security sensitivity

state estimation synthesis theory transfer functions Systems concepts design engineering methodology

#### Т

Tachometers

Target control tracking tracking filters Targets Tasks Teaching Technological forecasting Technology transfer Telecommunication Telecontrol Telemanipulation Telematics Telemetry Teleoperation Telephone networks Telephones Telerobotics Telescope detectors Telescopes Television systems Temperature calculations coefficients control distributions measurement profiles Temporal logic reasoning Terminal control reliability voltages Terminals Termination Terms Ternary logic Test data adequacy generation length Testability Tests Thermal conductivity superconductors degradation diffusivity equilibrium nitridation noise properties stability Thermistors Three-term action control controllers Threshold currents decomposition functions logic of resolution selection value voltage Thresholds Throughput Time constants delay

estimation spread -domain analysis calculations correlations method reflectometers responses spectroscopy domains -frequency localization representation -invariant plants systems lag -optimal control Petri-nets response reversal schedule control controllers -series analysis -shared control -sharing programs -sharing systems signals -slot assignment synchronisation systems -varying plants -varying systems Timed Petri-nets Timing analysis jitter . recovery simulators Tissues Token-ring protocol Tolerance Tolerant Top-down methods Torque amplifiers control motors synchro Torsional vibration dampers Tracking applications characteristics systems Traction assistance control spinout control yaw control Trade offs Traffic control Train control Training Trajectories Trajectory planning Transactions Transceivers Transcoders Transconductance Transconductors Transducers Transductor elements Transfer contacts elements function matrices functions Transformation matrices Transformations Transformer oil Transformers Transforms Transient analysis deviation electrical discharges energy transfers errors

-delay

gratings oscillations radiation responses scattering signals stability analysis assessment states system deviation torque Transistors Transition matrices modes noise systems time Transmission characteristics electron microscopy line matrices line resonators lines systems zeroes Transmitters Transponders Transport delay properties Transportation control Transversal filters Travelling salesman problem wave amplifiers modulators waves Tree attenuation searches structures Trees Trends Triangular resonators Tribochemical wear Trigger elements Triodes Triplers Truth tables Tuneable filters Tuned power amplifiers Tuning characteristics Tunnel junction receivers iunctions Turbines Turbulence Turbulent convection Turing machine Turnkey systems Two -dimensional systems -phase induction motors -speed controllers -term action control controllers Tyres

### U

Ultrasonic transducers Uncertain *dynamic systems linear systems polynomials* Uncertainty Uncontrollable Undamped frequency Understeer Uniform electric fields Uniformity Uniglar

charge injection converters injection Unique action Uniqueness Unit action potentials commitment problem impulse step function response Units Universal control data compression Universe Unmonitored control systems Unobservable Unreliable machines Unstable Upper atmosphere Urban systems User interfaces Utility functions

#### V Validation

Validity Valves Vane pumps Variability Variable -delivery pumps -length codes -structure control structures -structure systems valve timing control Variables Variance matrices Variational analysis Vector quantization quantizers Vectors Vehicle aerodynamics dynamics simulators suspension Vehicles Velocity control errors feedback measurements overshoot saturation Verification Vibration dampers measurement View angles Views Virtual reality Viscous damping friction Visibility Visual motion pattern recognition Voltage amplifiers characteristics collapse control distribution inverter switches stability stabilizers standards Volterra

*series* Voltmeters Volts

### W

Waiting times Walking Walsh function Ward Leonard drive Warehouse automation Waste treatment Water pollution Wattmeter Wave *equations guides* Waves Weibull distribution Weighted moving average Weightling functions Wheels White noise Wide area networks Wide area networks Width Wiener filters Wind *speeds* Windmills Windup Work organization

### Y

Yaw rate Yourdon

### Ζ

Zero crossings drift error frequency -order hold sets transfer function transformation

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