Robotics

An International Bibliography with Abstracts

Alan Gomersall
Penny Farmer

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Robotics

An International Bibliography with Abstracts

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Alan Gomersall, M.Phil., B.Sc.(Eng).,M.I.Inf.Sc.

Graduated as a mechanical engineer through London University and joined the English Electric Co. Ltd as an information officer. After six years lecturing in information science at Leeds Polytechnic he is now Head of Greater London Council Research Library. Previous publications include: "Thesaurafacet: A Classification and Thesaurus for Science and Technology", "Traffic Noise: A Review and Bibliography", "Robotics Bibliograpy 1970-1981", and "Machine Intelligence — An International Bibliography with Abstracts on Sensors in Automated Manufacturing".

Penny Farmer, MA, M.I.Inf.Sc.

Qualified in Librarianship at the College of Librarianship Wales. Obtained an MA degree in the Faculty of Arts at Edinburgh University. After graduating at Edinburgh, joined the Middle Temple Law Library. In 1974 she joined the staff of the GLC Research Library first in the capacity of Acquisitional Librarian and then Head of Library Services. In 1980 also took on responsibility for all computer services in the library including management of the Acompline Database.

On moving to South Wales in 1982 with her husband and following the birth of her daughter is currently part-time Information Officer for Wales MIND (National Association for Mental Health) and freelance author of bibliographic publications. Previous publications include literature reviews on "Emergency Planning and Vandalism", "A Guide to the Acompline Database", "Robotics Bibliography 1970-1981", and "Energy Conservation in Buildings 1973-1983".

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Introduction

In 1981 when we compiled "Robotics Bibliography 1970-1981" we covered the substantive literature from the previous 10 years on the research and development of the industrial robot. The 1800 references in that bibliography traced its development from a research tool to its position in 1981 as a potent force on the edge of the production engineering scene which had not yet been fully harnessed. The references indicated the limitation of the robot in that only about 25% covered practical industrial applications, and many of these were limited to research and/or development tests of applications within the confines of the laboratory. Furthermore, the section on management and socio-economic issues was extremely short, for the simple reason that there was little practical experience available on human-robot interaction.

Three years later, it is apparent that the industrial robot has come of age! A further 1200 references cover all aspects of robot technology, and a separate volume "Machine Intelligence" has been found necessary to give justice to the intensive research being carried out on sensors, computer vision, and artificial intelligence in production engineering.

In this new Robotics Bibliography practical applications now constitute 30% of the total and there are more substantial sections on social impact, industrial relations and safety. In addition there are now significant contributions on the management, financing, and economics of industrial robot technology.

As in the previous bibliography significant contributions from research workers and production engineers from the major industrial countries are included, and here we have noted developments in countries such as China and Spain, relatively new to industrial robot technology.

Every effort has been made to include only those documents which are easily accessible from academic or special libraries, or national collections; and of course, organisations active in this field can always help trace or supply specific documents or papers. A representative list of these organisations is included in this bibliography.

Alan Gomersall
November 1984

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1

General Literature

1.1. STATE-OF-THE-ART REVIEWS

1.1.1. USA

1.1.1. (1) Robots – The next generation.

Hitchcox, A. *Power Transmission Design*, 23(10): 55–56, 58–60, 1981.

Reviews the research presently conducted in the USA on the controller and sensing systems particularly vision, audio, tactile and intelligence.

1.1.1. (2) Some critical areas in robotics research.

Holzer, A.J. (Carnegie-Mellon University, USA). *Computer Industry*, 2(3): 199–208, 1981.

The general field of robotics is briefly reviewed. Computer vision and compliance are identified and discussed at some length. Some comparisons between the various approaches to the vision question are made, and active and passive force measurements are contrasted. Hierarchical control, manipulators, grippers and fixtures are also considered. (40 refs.)

1.1.1. (3) DARPA (Defense Advanced Research Projects Agency) Program Intelligent Task Automation (ITA).

Van Reuth, E.C. and Levinthal, C. (Defense Advanced Research Projects Agency, USA). In, *Proc. 4th Meeting of the Coordinating Group on Modern Control Theory*, 27–28 October 1982, Rochester, Michigan, USA, Part I, AD.A128964. Presented at *4th IFAC/IFIP Symp. on Information Control Problems in Manufacturing Technology*, 26–28 October 1982, Gaithersburg, MD.

Gives an overview of the efforts of the Defense Advanced Research Projects Agency and the Air Force Wright Aeronautical Laboratories to plan and fund technology development for a substantial leap in Intelligent Task Automation. In addressing the needs for high productivity in manufacturing and robust applications to complex military tasks, the ITA program develops and integrates the generic technologies affecting, gripping, sensing, viewing, recognising and understanding the environment, controlling manipulation, and intelligently providing command of the task.

1.1.1. (4) Industrial robots present state of development.

Tooele Army Depot, USA. In, *Minutes of the 20th Explosives Safety Seminar*, 24–26 August 1982, OMNI International Hotel, Norfolk, Virginia, USA, Volume I, AD-A124 400, 1982.

The Directorate for Ammunition Equipment (D/AE) has been instrumental in the use of robots on ammunition related projects for either increasing the productivity or safety of a particular process. Experience has included use of an industrial robot to load and unload three detracer machines on a 40mm ammunition renovation line at Tooele Army Depot; and assignment as consultant to HQ ARRCOM for the installation of three large ton capacity robots at the Western Area Demil Facility in Hawthorne, Nevada. Uses robots in the common role of handling and transferring of material items. The items to be handled were mechanically delivered to an exact position where the robot then checked input signals supplied by interfaced equipment. It would then load and unload the machine it serviced.

1.1.1. (5) Robots in the US – How they will affect industry.

Smith, D. (University of Michigan, USA). *Production Engineering*, 61(12): 22–23, 1982.

Discusses study of industrial robots carried out in the USA which forecasts that by 1990, the number of workers displaced from their jobs by robots will have doubled to almost 7%. But over the next ten years, 88% of workers displaced by robots will find new positions within the same company with 63% of them retrained for working in-house with robotics.

1.1.1. (6) Tutorial workshop on robotics and robot control.

Army Tank-Automotive Command, USA. National Technical Information Service Report No. AD-A134 852/0,1982.

The first session deals with robot mechanisms, sensors and control. Kinematic and dynamic models of robots are introduced together with illustrations of existing industrial robots. Both internal and external state sensors are discussed together with alternative feedback control schemes. The second session is devoted to the mathematics and computer programming of robot control. Homogeneous transformations, *kinematic equations and their solution, motion trajectories and differential relationships are discussed as they relate to the control of robots. The third session treats topics in the area of visual sensing for robot control. The major topics are: sensing and preprocessing, segmentation, recognition and interpretation, and representation of scene data.*

1.1.1. (7) High technology industries: Profiles and outlooks. The robotics industry.

International Trade Administration, USA. National Technical Information Service Report No. PB83-211144, 1983.

Assesses the international competitive position of the US robotics industry; pinpoints the major foreign and domestic challenges to American robot producers; and suggests possible options for US government policies affecting the sector's international standing.

1.1.1. (8) Information control problems in manufacturing technology 1982.

Proc. 4th IFAC/IFIP Symp., 26–28 October 1982, Gaithersburg, MD, USA. Pergamon Press, Oxford, UK, 1983.

Covers government activities in manufacturing control, manufacturing process control, measurement techniques, robotics, planning and control and manufacturing systems.

1.1.1. (9) Production research and Technology.

Proc. 10th Conf. on Production Research and Technology, 28 February – 2 March 1983, Detroit, Michigan, USA. Society of Automotive Engineers, Warrendale, PA, USA. NTIS Report No. PB83-223313, 1983.

Papers fall into the following categories: production management and design, casting and forging, machining, inspection and assembly, arc welding, robots, and varied research topics. Freeze-dry preparation of leather for rapid tanning, through-the-arc sensing for arc welding, drilling rates of various metals in liquid tin-zinc, machine intelligence research applied to industrial automation, part mating theory for compliant parts, models for planning and controlling production in multi-stage production systems for discrete parts, and the use of tactile sensing and computer-graphics in the automation of mould-production for plastics processing are the topics covered.

1.1.1. (10) Researchers push towards programmable assembly systems.

Rooks, B.W. *Assembly Automation*, 3(3): 143–146, 1983.

Examines research being conducted at the University of Massachusetts to make assembly more flexible. Although the robotic assembly system uses the same approach and techniques as manual and automatic assembly, the criteria for robotic assembly are still being developed. Data from industry show that for assembly by robots the need is for a two-arm four-degrees-of-freedom device. Programmable feeders and grippers are covered.

1.1.1. (11) Robotics and industrial inspection.

Proc. SPIE Robots and Industrial Inspection, 24–27 August 1982, San Diego, CA, USA. SPIE, Bellingham, WA, USA, 1983.

45 papers cover government programmes in robotics, Department of Defense research and applications, image processing algorithms, time-varying image processing and control, industrial robotics, industrial applications of computer vision, and object perception and mensuration for robotics.

1.1.1. (12) Robotics research projects report.

Hsia, T.C. (Dept. of Energy, USA). Report No. UCID-19816, 1983.

Summarises the research results of the Robotics Research Laboratory. Areas of research include robotic control, a stand-alone vision system for industrial robots, and sensors other than vision that would be useful for image ranging, including ultrasonic and infra-red devices. One particular project involves RHINO, a 6-axis robotic arm that can be manipulated by serial transmission of ASCII command strings to its interfaced controller.

1.1.1. (13) Survey of robotic technology.

Castore, G. (David W. Taylor Naval Ship Research and Development Center, USA). Research and Development Report No. DTNSRDC-83/053, 1983.

Robotic Technology is surveyed as a prelude to examination of its use in naval air maintenance tasks. Robot classification schemes, programming techniques, power systems, manipulators, control systems, sensors, and end effectors are surveyed. A robot is defined as a machine with three components: a manipulator to move objects and tools; a controller to store data and direct the manipulator; and a power system for the manipulator.

1.1.1. (14) Trends of flexible automation using industrial robots in the USA.

Felsing, W. *ZWF Z. Wirtsch. Fertigung*, 78(11): 507–13, 1983. (In German)

The number of industrial robots in the USA has trebled since 1979. Describes applications, pictures actual installations as well as show-room models, and gives a list of names and addresses of suppliers.

1.1.1. (15) New perspectives: The Upjohn report.

Schreiber, R.R. *Robotics Today*, 5(2): 61–62, 1983.

The Upjohn report examines the impact of robots on the USA and on Michigan in particular. The results of this study in terms of robot population growth, occupation profiles, job displacement, and new job creation are discussed.

1.1.2. Europe (inc. UK and USSR)

1.1.2. (1) Expanding the use of robots for assembly in the Soviet Union.

Yurevitch, E.I., Fedoror, Yu.A. and Fedoror, A.I. (Leningrad Polytechnic Institute, USSR). *Assembly Automation*, 1(5): 258–260, 1981.

Discusses flexible integrated assembly lines which are beginning to appear in the USSR. In one example, a wide variety of tuned-circuit coils for radio receivers are put together on a robot assembly system. (5 refs.)

1.1.2. (2) Robots in France: From intelligent robots to flexible manufacturing systems.

Coiffet, P. (CNRS, France) and Laurgeau, C. (University of Nantes, France). *Nouv. Autom.*, 26(22): 62–68, 1981. (In French)

A review of French research in robotics. The main subjects of research which laboratories are working on are enumerated. The research concerns mechanics and technology, requirements of robots, man-robot relationship, and the application of robots in production leading to flexible manufacturing. On this last point, the four main components are: programmed automation of machines, versatility of transfer-units, storage of works and tools, and data processing system of integration.

1.1.2. (3) Soviet robotics.

Soviet Engineering Research, 1(8), 1981.

Issue covers: industrial robots in mechanical assembly, experience in development of robot grippers, problems of remote control of industrial robots, ways for improving the dynamic and static characteristics of electrohydraulic robot drives, problems of designing industrial robots with telescopic elements, standardisation problems in industrial robotics.

1.1.2. (4) New support impulse in the area of industrial robots.

Martin, T. (Kernforschungszentrum Karlsruhe, West Germany). Report No. KFK-PFT-25, 1982. (In German)

Report of a workshop at which problems of industrial robots were discussed by suppliers, users, and researchers. Such robots are used for handling workpieces and tools in the manufacturing industry. Describes the state-of-the-art and latest experiences, development deficiences are identified in detail. This includes hardware and software as well as handling applied product design and methods and tools for systems planning.

1.1.2. (5) Robotics.

Ann. Mines, 189(5–6), 1982. (In French)

Special issue devoted to robotics, covers social aspects, maintenance in the nuclear industry, automation in manufacturing, artificial intelligence and end effectors.

1.1.2. (6) Swedish industries experience with robots.

Carlsson, J. and Selg, H. (Comput. and Electron Comm., Sweden). *The Industrial Robot*, 9(2): 88–91, 1982.

Based on leading-edge technique analysis, the diffusion of industrial robots in Sweden during the 70's and a forecast for the 80's is presented. Actual use of robots and NC-machines in small-batch manufacturing and bariers as well as policies for promoting a wide diffusion of robots are discussed.

1.1.2. (7) Automate to survive – Industrial robots.

Syst. Int., 11(4): 28–34, 1983.

Reviews the current market for industrial robots and gives details of 26 manufacturers, from Ajax to Unimation. Trends in future technology are outlined also.

1.1.2. (8) The economic and social issues of applied robotics.

Lasfargue, Y. In, *Proc. Productivity and Data Processing: Two Essentials for a Dynamic Company, Spring Convention*, 30 May – 3 June 1983, Paris, France, Vol. 1, pp. 114–18. Printemps Convention, Paris, France, 1983. (In French)

Describes the main economic and social issues of robotics: productivity, profitability, job volume and quality, vocational training, freedom, and new products. It goes on to explain the proposals of UCC-CFDT, which has made a special study of the question, and is in favour of developing robotics provided that the employees control this development. Implementation of the new French Auroux Laws, giving more rights to employees, should foster consultation concerning robot systems.

1.1.2. (9) The effective utilisation of robots: The management of expertise and knowhow.

Fleck, J. (University of Aston, UK). In, *Proc. 6th British Robot Association Annual Conf.*, 16–19 May 1983, Birmingham, UK, pp. 61–70. British Robot Association, Bedford, UK, 1983.

The UK robot awareness campaign appears to have been won, with a clear take off in the numbers of robots sold and a current annual diffusion rate in excess of 50%. An analysis of the patterns of success and failure in an empirical study of over 40 firms adopting or considering robots indicates, however, that there is little room for complacency: considerable effort is required for the effective adoption of robotic systems and comparison with other cases of industrial innovation confirms the crucial importance of scarce experienced manpower and knowhow resources. The focus must now shift from a preoccupation with numbers and rates to the careful management of these resources, and to the effective utilisation of robots.

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1.1.2. (10) The fall-out from the Ministry of Research and Industry's Robotics Task Force: The national robotics production plan.

Petiteau, M. In, *Proc. Productivity and Data Processing: Two Essentials for a Dynamic Company, Spring Convention*, 30 May – 3 June 1983, Paris, France, Vol. 1, pp. 109–12. Printemps Convention, Paris, France, 1983. (In French)

In order to be competitive, manufacturing industry must be able, not only to improve productivity, but also to meet a highly diversified demand. To date this high productivity has always been achieved by a rigid system of automation compatible with mass production. Production runs had, therefore, to adhere to two requirements – a sufficiently long life and a completely rigid definition of the products. More flexible methods for short and medium production runs were developed in nonjob-specific shops. This paper describes the advantages offered by robots for the setting up of nonjob-specific assembly lines similar in their organisation to the machining centres already in existence.

1.1.2. (11) Flexible automation multi-robot systems.

Puente, E.A. *Mundo Electron.*, (130): 81–89, 1983. (In Spanish)

The automation field has been expanded, spurred mainly by two key factors; namely: the necessity to adapt the production process to the requirements of a heavily changing market and for a partial or full optimisation of the production system. First reviews the structure of the productive system in terms of process and assembly steps as a general introduction to DISAM/2, an experimental system which is being developed at Departamento de Ingenieria de Sistemas y Automatica de la ETSII in Madrid. (6 refs.)

1.1.2. (12) Flexible automation with industrial robots.

Schweizer, M. (IPA, West Germany). *Automobiltech Z*, 85(6): 3–5, 8–10, 1983. (In German)

Although robots today are used mostly for spot welding and coating, more and more new areas of application are becoming apparent. This report covers the use of industrial robots both in Germany and abroad, concentrating on the various areas of application and future development. It is shown how such developments will depend on the sensor systems available.

1.1.2. (13) Flexible manufacturing systems – A review.

Sims, R.B. *Electron. and Power*, 29(11–12): 809–812, 1983.

Flexible manufacturing systems (FMSs) employing robotics technology are emerging as the processes to carry engineering manufacture into the 21st century. The UK situation is assessed.

1.1.2. (14) The great robotics explosion.

Rathmill, K. (Cranfield Institute of Technology, UK). *Management Today*, July, pp. 82–87, 1983.

In view of the intense competition that is building up in what is currently a very limited volume market in the UK, a violent shake-out is widely predicted. There is ample evidence that numbers of British companies in the robotics field have been facing serious difficulties but the leading example of high automation in UK manufacturing industry is the 600 Group's Scamp system. This uses eight robots in a very sophisticated computer-controlled parts-machining system which is capable of responding to small batch sizes and high product variety. Relative to its position in the robot population league, the UK possesses superior facilities in training, research, government support and information.

1.1.2. (15) Industrial robots for automating production processes.

Panov, A.A. *Soviet Engineering Research*, 3(1): 54–57, 1983.

An analysis of design and production features of industrial robots developed in Sweden. Applications include adhesive bonding, deburring, spot-welding, inspection gauging and other heavy and exhausting jobs, in which the robot can ease the burden on human operatives.

1.1.2. (16) Industrial robots – Present position, new applications and limitations.

Schraft, R.D. *Elektrotech. Z. ETZ*, 104(11): 519–523, 1983. (In German)

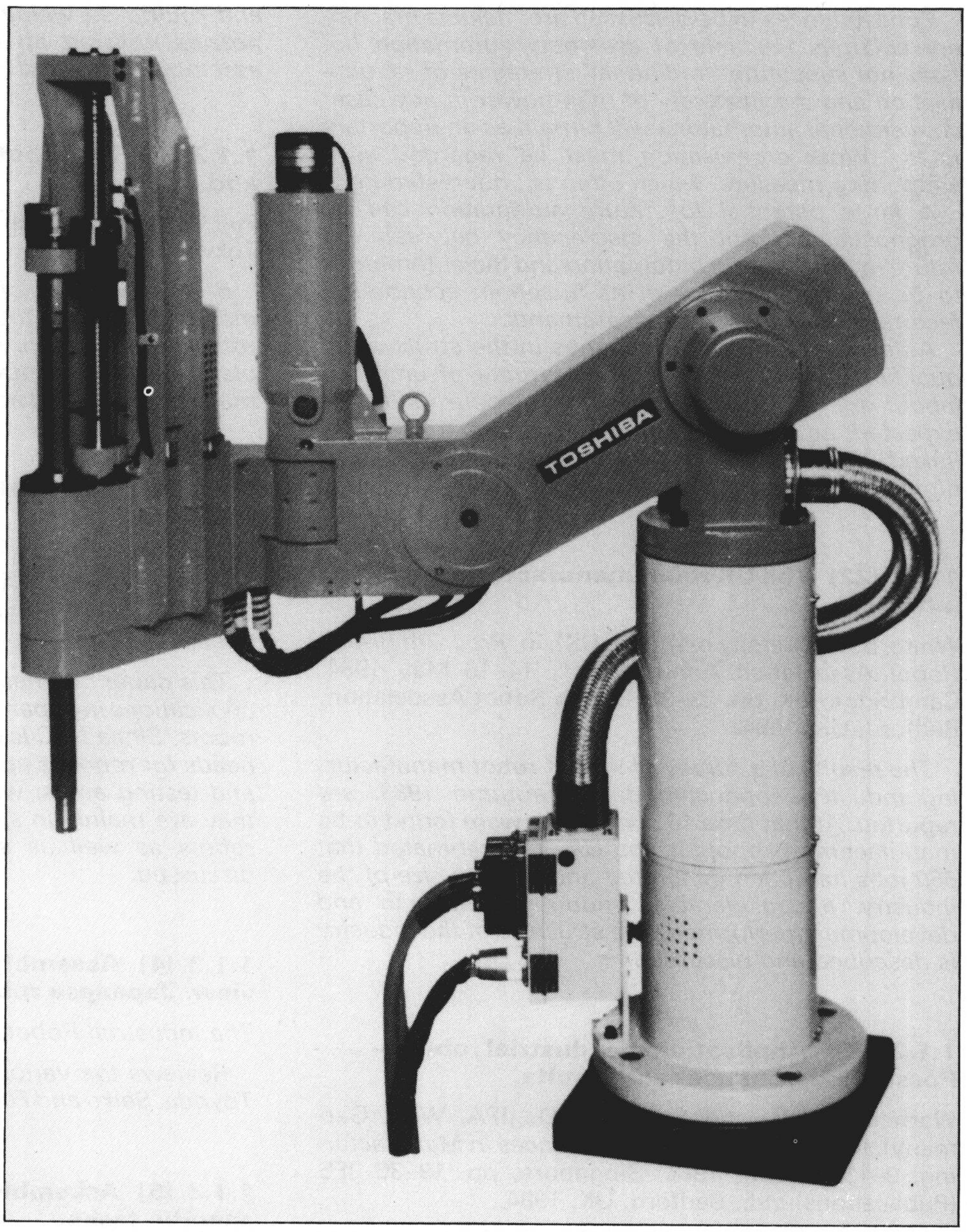
Statistics are given which show the increase in the use of robots in German industry in recent years and possible developments in various industries are described. The limitations of sensors is one obstacle to further progress. (5 refs.)

1.1.2. (17) Making the most of Japanese assembly robot technology.

Rooks, B.W. *Assembly Automation*, 3(4): 195–197, 1983.

A report on one of the emerging UK companies in the robotics business with a strong Japanese link, Evershed Robotics based in Chertsey, Surrey. This company has a licensing agreement with Toshiba Seiki to market its range of robots in the UK, West Germany, Austria and Italy. Currently this involves the marketing of three types: the TSR series of assembly robots; the IX-15 hydraulic drive spot welding and general handling robot; and the T series of electric drive multi-arm spot welding robots. The TSR series of assembly robots are attracting attention and generating business for Evershed. So far four of the assembly machines have gone into the electronics industry and two into the automotive. One of the latter is for the assembly of rocker covers for automobile engines.

Toshiba's TSR-701H assembly robot (See 1.1.2.(17))



1.1.2. (18) Snapshot of the robot situation.

Bey, I. *Ind. -Anz.*, 105(47–48): 35–37, 1983. (In German)

Brief review of the suppliers of industrial robots and their main products. Producers are divided into West German firms, and others supplying the German market. The degree to which the installation of industrial robots is growing in the most highly industrialised countries is discussed. (12 refs.)

1.1.2. (19) UK shows robot growth but the pace must quicken.

Metalworking Production, 127(4): 77, 80, 84, 1983.

Overviews the UK robot population figures and underlines the need for quickening the pace of robot growth. Also examines a new range of miniature robots, and assesses the merits and limitations of a new industrial robot that applies adhesives and sealants.

1.1.2. (20) Europe overtakes the USA.

The Industrial Robot, 11(1): 38–41, 1984.

Annual statistics of robot applications. Tables include the world robot population, applications breakdown, growth of UK and West German robot populations and analysis of robot applications in the UK. Robot population density in relation to industrial workforce in 8 countries is also presented.

1.1.2. (21) Perspectives and social implications of assembly automation in West Germany — Some results of a representative inquiry.

Seitz, D. and Volkholz, V. (Gesellschaft für Arbeitsschutz und Humanisierungsforschung, West Germany). In, *Proc. 5th Int. Conf. on Assembly Automation*, 22–24 May 1984, Paris, France, pp. 333–342. IFS (Publications) Ltd., Bedford, UK, 1984.

Consequences to be discussed are: flexible machinery enlarges the field of assembly automation but does not substitute 'traditional' strategies of rationalisation and the flexibility of man-power in any case; conventional automatons will remain as an important factor. Work organisation must be regarded as a supporting measure, which often is underestimated.

A large potential for future automation can be prognosticated, but the discrepancy between the future investments in automation and the automatons to be in planning as well as uncertain economical factors complicate exact assessments.

Automation implicates changes in the structure of qualifications. A decrease of the quota of unskilled labour for the benefit of skilled labour is to be expected; as the shifting of qualification structures is linked with increasing displacements, there will be higher demands for personnel planning.

1.1.2. (22) The UK robot manufacturing industry.

White, B. (University of Aston, UK). In, *Proc. 7th British Robot Association Annual Conf.*, 14–16 May 1984, Cambridge, UK, pp. 23–30. British Robot Association, Bedford, UK, 1984.

The results of a survey of the UK robot manufacturing industry, conducted during autumn 1983, are reported. At that time 18 companies were found to be manufacturing robots in the UK. It is estimated that 660 jobs had been generated and, for the size of the industry, a considerable amount of research and development performed. The structure of the industry is described and discussed.

1.1.2. (23) Application of industrial robots – Possibilities, chances and results.

Warnecke, H.-J. and Schraft, R.D. (IPA, West Germany). In, *Proc. Int. Conf. on Advances in Manufacturing*, 9–11 October 1984, Singapore, pp. 19–30. IFS (Publications) Ltd., Bedford, UK, 1984.

Industrial robots have been familiar in the industry since 1965. The first significant applications were in Europe in the early 70's and by the end of 1983 approx. 13,700 industrial robots were in use in Europe. The application areas can be divided into tool handling and workpiece handling. On examining the robot applications in the Federal Republic of Germany, one finds that approx. 50% of the devices are applied in the automobile industry. Apart from the classic application areas such as spot welding, the loading of machines and arc welding, large numbers of new applications are expected in the future in the machining, loading and unloading of machines as well as the assembly fields. The paper gives an overall view of the state-of-the-art, as well as of further potential application areas.

1.1.3. Japan

1.1.3. (1) Japanese robotics.

Hitachi Review, 30(4), 1981.

Issue contains articles on automation of gas cutting and multipass welding process for pressure vessel nozzles utilising an industrial robot; an intelligent assembly robot; and Hitachi industrial robots.

1.1.3. (2) The robotics industry of Japan today and tomorrow.

Fuji Corporation, Japan Industrial Robot Association. Tokyo, Japan, 1982.

English version of report entitled 'long-term demand forecast of industrial robots' (1981). Looks at robot use in Japan, demand factors and installation plans, demand forecasts and applications in both the manufacturing and non-manufacturing sectors.

1.1.3. (3) Applications of assembly robot in NEC.

Kondo, M. (Nippon Electric, Japan). In, *Proc. 2nd European Conf. on Automated Manufacturing*, 16–19 May 1983, Birmingham, UK, pp. 403–412. IFS (Publications) Ltd., Bedford, UK, 1983.

This paper outlines recent trends of industrial robot applications in Japan, and NEC's assembly and testing robots. Since NEC is an electronics manufacturer, the needs for robotics application are mainly in assembly and testing areas, while in the automotive industry, they are mainly in spot welding and painting. NEC's robots as well as some application examples are discussed.

1.1.3. (4) Assembly and greater precision in view. Japanese robotics developments.

The Industrial Robot, 10(2): 126–131, 1983.

Reviews the various assembly robots designed by Toyoda, Seiko and Fujitsu.

1.1.3. (5) Assembly robot sensors designed for specific tasks.

Inagaki, S. (Nagoya Municipal Industrial Research Institute, Japan). *Journal of Electronic Engineering*, 20(198): 85–89, 1983.

In Japan robot builders study one by one the potential areas for robot introduction and all move at the same time into an area after it is agreed that the area offers a good opportunity for robot introduction. Japanese manufacturers are confidently introducing robots into arc welding, and assembly work probably will be the next target of robot introduction.

1.1.3. (6) Japan builds more intelligent robots.

Aron, P. (Daiwa Securities America, USA). *The Industrial Robot*, 11(1): 14–17, 1984.

Japan's robot industry is engaged in a major shift in its production emphasis towards more sophisticated types of robots, according to the latest update of statistical information. Tables include robot production by cost and numbers produced, forecasts of production, and the monthly production plans of 13 Japanese robot construction companies.

1.1.3. (7) State-of-the-art of automatic assembly in Japan.

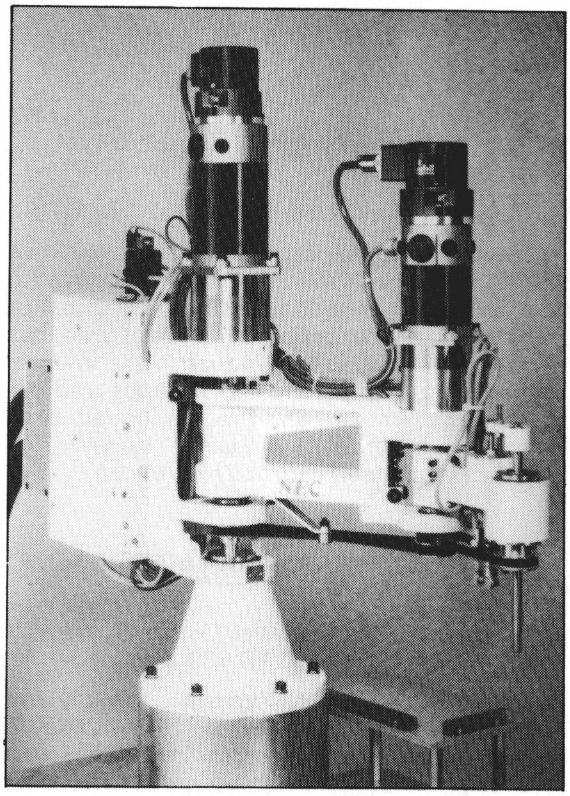
Makino, H. (Yamanashi University, Japan) and Yamafuji, Y. (University of Electro-communications, Japan). In, *Proc. 5th Int. Conf. on Assembly Automation*, 22–24 May 1984, Paris, France, pp. 1–22. IFS (Publications) Ltd., Bedford, UK, 1984.

In both fixed and flexible automation Japan has much experience. Generally, mass production products are assembled in high-speed automatic assembly machines using cam-operated mechanisms and dedicated parts feeders. Recently a major change is taking place in the manufacturing processes – that is flexible automation. Not only machining but also assembly processes are being automated with robots and other flexible equipment. Examples are shown and the reason why flexibility is needed is discussed.

1.1.3. (8) Robotization and its future outlook in Japan.

Yonemoto, K. (Japan Industrial Robot Association (JIRA)). In, *Proc. 14th Int. Symp. on Industrial Robots/7th Int. Conf. on Industrial Robot Technology*, 2–4 October 1984, Gothenberg, Sweden, pp. 733–742. IFS (Publications) Ltd., Bedford, UK, 1984.

At present, Japan is the leader in utilising industrial robots with approximately 50% currently operating worldwide. In the USA and Europe utilisation is expected to increase about 30% per annum. Factors favouring diffusion include the need to improve productivity, efforts to prevent accidents and health hazards, and a current shortage of skilled labour due to the tendency toward a more highly educated society.



NEC's Model-C assembly robot (See 1.1.3. (3))

1.2. BIBLIOGRAPHIES

1.2. (1) Industrial robots in mechanical engineering.

Vorobiev, E.I. *Soviet Engineering*, 2(12): 6–19, 1982.

Discusses the experience gained by Soviet and foreign industry in the creation of robotised production facilities in various industries. The most effective areas of robot application in different branches of the mechanical engineering industry are analysed, the main development trends of robotics and problems arising from the creation of robotised production facilities are shown. A useful review of Soviet literature is included with 199 references.

1.2. (2) NOSC/ONR robotics bibliography (1961–1981).

Harmon, S.Y., et al. (Naval Ocean Systems Center, USA). Report No. NOSC/TD-539, 1983.

A bibliography of the literature directly related to robotics published from 1961 to 1981. 1066 references are organised into ten topical categories including: general and historical topics; modelling, simulation, design, testing and evaluation, sensors and sensor data processing; operating systems, software development, programming languages and computer architectures, knowledge management; communications and direct robot/human interactions; dynamics and control; effectors; systems and applications, and safety, human factors, standards, management, social, economic and political issues.

1.2. (3) Anatomy of industrial robots and their controls.

Luh, J.Y.S. *IEEE Trans. Automatic Control*, 28(2): 133–153, 1983.

Broad review which includes an account of sensory devices, compliance, vision, command languages, etc. Useful for its 106 accurate references which include many papers on artificial intelligence, pattern recognition, feedback, imaging, etc.

1.2. (4) Artificial intelligence. 1972–March 1983 (Citations from the International Aerospace Abstracts Data Base).

National Technical Information Service Report No. PB83-861575, 1983.

Topics include pattern recognition theory and algorithms, image processing, automatic word processing, computer aids in pattern recognition, talking and answering systems, and robotics. (284 refs.)

1.2. (5) Artificial intelligence. April 1983–December 1983 (Citations from the Engineering Index Data Base).

National Technical Information Service Report No. PB84-856350, 1983.

Citations concerning artificial intelligence. Topics include pattern recognition theory and algorithms, image processing, automatic work processing, computer aids in pattern recognition, talking annd answering systems, systems for the medical profession, and robotics. Applications in the aerospace industry are also included. (64 refs.)

1.2. (6) Robot manipulators: Program control. 1975–September 1983 (Citations from the International Information Service for the Physics and Engineering Communities Data Base).

National Technical Information Service Report No. PB83-872994, 1983.

Citations concerning the control of robot manipulators for industrial, commercial, personal and medical applications. Modelling and synthesis for robotic programmable manipulative machinery control systems for a variety of tasks with a wide range of difficulty factors are emphasised. (236 refs.)

1.2. (7) Robot welding. 1970–August 1983 (Citations from the Engineering Index Data Base).

National Technical Information Service Report No. PB83-870501, 1983.

Contains citations concerning the design, manufacture, and industrial applications of industrial robots and teleoperators for welding operations. Arc welding and spot welding operations are the processes emphasised. Performance evaluations of welding robots presently operating in many industrial environments are discussed relative to such factors as design change recommendations, feature peculiarities, quality control, and economics. (94 refs.)

1.2. (8) Robot welding. 1975–July 1983 (Citations from Information Services in Mechanical Engineering Data Base).

National Technical Information Service Report No. PB83-867697, 1983.

Citations concerning resistance spot welding, arc welding, metal cutting, and gas welding with reference to robot application. Industrial robot replacement of skilled welders, performance evaluations of welding robots in various industries, and welding seam sensing device technology are also included. (141 refs.)

1.2. (9) Robot welding. 1976–November 1983 (Citations from the International Information Service for the Physics and Engineering Communities Data Base).

National Technical Information Service Report No. PB84-852268, 1983.

Citations concerning innovations in the state of the art of robot welding technology. Software for the control of industrial welding robots, utilisation of robots for arc welding as well as cutting processes, *future possibilities for the industrial robot in small and large welding shops, and tactile sensing devices for the guidance of welding robots are among the topics discussed. Performance evaluations of welding robots in various manufacturing areas are included. (154 refs.)*

1.2. (10) Robots. 1964—March 1982 (Citations from the NTIS Data Base).

National Technical Information Service Report No. PB83-808089, 1983.

The bibliography cites research on the design and application of robots. It includes studies on software development, memory models, and manipulation control algorithms. Also included are the many problem solving features of robots and space exploration applications. (243 refs.)

1.2. (11) Robots. April 1982—July 1983 (Citations from the NTIS Data Base).

National Technical Information Service Report No. PB83-808097, 1983.

Cites research on the design and application of robots. It includes studies on software development, memory models, and manipulation control algorithms. Also included are the many problem solving features of robots and space exploration applications. (125 refs.)

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