Richard M. Voyles

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Carnegie Mellon University:

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EDUCATION:

Ph.D. Carnegie Mellon University	Robotics Ph.D. Program (School of Computer Science), 9/90 - present. My thesis focuses on Gesture-Based Programming for robotic contact tasks, a paradigm for non-textual programming by human demonstration. This requires the design of novel tactile sensors and actuators and a powerful, autonomous calibration technique I call Shape from Motion Primordial Learning. My advisor is Pradeep Khosla. GPA = 3.7/4.0
MSE Stanford	Manufacturing Systems Engineering (division of Mechanical Engineering), 9/87 - 6/89. Emphasis on robotics and controls as well as manufacturing. GPA = 3.8/4.0
BSEE Purdue	Electrical Engineering, 8/80 - 5/84. Completed course work for the BSEE in three years with GPA = 5.6/6.0. Left MSEE program when my advisor, Richard Paul, went to Penn.
non-degree	Various IBM-sponsored mini-courses on optics, digital signal processing, factory automation, electronic testing and artificial intelligence, 7/84 - 12/86.

TEACHING INTERESTS:

Robotics, Computer Vision, Mechatronics, MEMS, Manufacturing Methods, Entrepreneurial Engineering, Computer Engineering

TEACHING EXPERIENCE:

Broome Community College, Binghamton, NY — **May 86 - Dec. 86**

Adjunct physics instructor teaching one lab and two lecture sections per semester to associate's- and bachelor's-degree candidates while full-time at IBM. I was fully responsible for developing syllabi, setting class policy, delivering lectures, and grading assignments.

Carnegie Mellon University, Pittsburgh, PA — **1993**

Co-developed a graduate mechatronics course proposal for CMU Robotics Ph.D. program.

PROFESSIONAL/RESEARCH EXPERIENCE

Carnegie Mellon University, Robotics Institute, Pittsburgh, PA — **Aug. 90 - present**

Currently developing multi-agent gesture recognition software as a new human demonstration-based programming paradigm. Developing novel intrinsic and extrinsic tactile sensors. Wrote device drivers and reusable, reconfigurable software modules ("port-based objects") in support of my thesis and the research of other Advanced Mechatronics Lab members. Maintained hardware and software for three PUMA, two Adept, and one American robot; a Utah/MIT Hand; and a mobile base.

Institute for Defense Analyses, Alexandria, VA — **Apr. 96 - Sept. 96**

Research Intern supporting the DARPA/ISAT summer study group for "Packet Robotics." This is a brainstorming group developing direction for DARPA's research agenda for the next 5 - 10 years. The group consists of Takeo Kanade, Ron Fearing, Bruce Donald, George Bekey, Steve Jacobsen, Rod Brooks, Randy Beer, Ken Gabriel and Pradeep Khosla.

Trident Robotics and Research, Inc., Wexford, PA — **Dec. 89 - present**

Founder and President. Design and implementation of robot control hardware and software for PUMA manipulators including board-level design and layout of R3000 RISC single-board computer for ISA bus, motion control I/O cards for VMEbus, Multibus, ISA bus, and IndustryPack bus. Software development for real-time joint PID control, forward and inverse kinematics, trajectory generation, I/O drivers, and user interface. Turnkey robot controllers.

Vigilant Technologies, Inc., Sunrise, FL — **Sept. 91 - Aug. 92**

Co-Founder and Vice President of Research. Real-time control hardware and software design for R3000-based real-time controller with IndustryPack-compatible I/O bus. Developed novel GUI for controller configuration. Wrote business plan.

Integrated Systems, Inc., Santa Clara, CA **Mar. 89 - Aug. 90**

Research Scientist in the real-time controls group. Project Manager for electrical and mechanical design projects for rapid control prototyping and PUMA manipulators. 80386 software and hardware for Multibus-II control computer. Wrote several proposals for government (SBIR) and corporate clients. (Including a solo trip to Nikon in Japan to write a proposal.)

Stanford University, CS Robotics Lab, Stanford, CA **Sept. 87 - June 89**

Research Assistant and "Lab Warrior" for Oussama Khatib and Bernie Roth. Developed software, instrumentation and sensors for closed-loop torque and position control of research manipulators. Built novel tactile sensor for dextrous hand under Mark Cutkosky.

IBM Corp., Endicott, NY **July 84 - Aug. 87**

Manufacturing/Test Engineer specializing in robotics and factory automation. Performed financial analyses for senior management and integrated a data driven robot for plugging integrated circuit modules into mainframe boards. Lead Engineer on box-level automated stress test of minicomputers. Pursued independent research in robotic odd-form component insertion, non-contact sensors using optical diffraction and fiber optic position sensors.

Massachusetts Institute of Technology, AI Lab, Cambridge, MA **July 83 - Aug. 83**

Summer internship in robotics and vision programming under Tomas Lozano-Perez. We studied manipulator kinematics and dynamics, wrote force-based manipulator programs in AML for the IBM 7565 6-DoF manipulator, and wrote binary vision routines in LISP.

Dart Controls, Inc., Indianapolis, IN **May 81 - Aug. 83 (summers)**

Designed, built and tested prototype AC, DC and brushless DC motor controls. Established in-house microprocessor programming and development capability. Designed and built a custom 5-axis robot for pick-and-place operations.

SIGNIFICANT VOLUNTEER EXPERIENCE:

IASTED International Symposium on Robotics and Manufacturing **1989-90**

Session chairperson, member of Publications Committee

WRFL/FM **1980-83**

Disk Jockey at a faltering student radio station at Purdue University. Became **Station Manager** for two years. Managed the budget, improved equipment and increased student participation tenfold to 70 DJ’s with a management staff of 7. Listenership also increased dramatically.

Purdue Engineer Magazine **1980-84**

Writer, business staff, then **Editor-in-Chief** for two years. The *Purdue Engineer* is an award-winning, student-run, self-supporting engineering magazine with a circulation of about 6000. During my tenure as Editor-in-Chief we reversed a long history of deficit spending that had depleted assets, returning it to profitability while improving the overall quality of the magazine.

HONORS:

Total externally-secured educational funding from grants and fellowships: ~$230K including Dept. of Energy **Integrated Manufacturing Graduate Fellowship**, 1995-98; **National Defense Science and Engineering Graduate Fellowship** (NDSEG), 1990-93; **ICEC/Apple Fellowship**, 1988; **Fessenden-Trott Scholarship**, 1983, 84; **Mortar Board** (Leadership Honorary), 1983-84; **Eta Kappa Nu** (EE Honorary), 1982-84; **Purdue 500** (top 500 GPA's university-wide), 1981, 82; **President's Honor Award** (Outstanding Freshman), 1980; Who’s Who, Who's Who in the West; National Dean's List; International Youth in Achievement; **Outstanding Student Exhibit Award**, 1995 IEEE Conf. on Systems, Man, and Cybernetics.

UNIVERSITY SERVICE:

Student Assistant for 1996 DARPA/ISAT summer study group (see Professional Experience)
Student volunteer at 1996 IEEE International Conference on Robotics and Automation
Student volunteer at 1995 IEEE International Conference on Systems, Man and Cybernetics
"Gesture-Based Programming" and "Reconfigurable Manipulator" contract reviews at Sandia, 1996
"Software Affordability for Real-Time Systems" demo at 1995 DARPA Intelligent Systems Symposium
Student volunteer at 1995 IEEE/RSJ Intelligent Robots and Systems Conference
2-week JSTMP tour of Japanese research facilities, 1995.
RoboCzar of RoboOrg (first president of robotics students’ association), 1994
CMU Graduate Student Organization Representative, 1994
Student member, Carnegie Mellon Robotics Institute Review Committee, 1993, 1994
Student Assistant for 1993 International Symposium on Robotics Research
Secretary, Stanford Engineering Club for Automation and Manufacturing, 1988-89
Student member, Purdue Electrical Engineering Curriculum Review Committee, 1982

ACTIVITIES AND ASSOCIATIONS:

Volunteer Coordinator for local candidate for state legislature, 1996; member, Institute for Electrical and Electronic Engineers; member, American Society for Engineering Education; member, Mensa; volunteer mechanic for "Re-Cycle a Cycle" program; intramural softball, basketball, football, indoor soccer, and outdoor soccer, 1991-96; Long Range Planning Committee, Wexford Presbyterian Church, 1995-96; Co-organizer of Stanford Start-Up Job Fair, 1989; programmer, Stanford Small Satellite Program, 1988; Senior Observer, Roberson-Kopernik Observatory, 1986-87; volunteer, Roberson Center for Arts and Sciences, 1985-87; Regional judge for "Odyssey of the Mind", 1986; Stewardship Committee, 1st Presbyterian Church, 1986; wrestling assistant, Union-Endicott High School, 1985-86; Pledge Coordinator, Purdue Reamer Club, 1984; Secretary, Purdue Residence Network, 1983; Co-newsletter editor and Grand Prix crew chief, Society of Women Engineers, 1983-84; Darkroom director, Shreve Camera Club, 1982-83; wrestling coach, Tecumseh Junior High School, 1982-83.

JOURNAL PUBLICATIONS:

R.M. Voyles, Jr., J.D. Morrow and P.K. Khosla, "The Shape from Motion Approach to Rapid and Precise Force/Torque Sensor Calibration," to appear, *Journal of Dynamic Systems, Measurement and Control*.

R.M. Voyles, Jr., "Non-Contact Bent Pin Detection Using Laser Diffraction" in *IEEE Transactions on Components, Hybrids, and Manufacturing Technology,* December, 1987. (Also in *Proc. of 1986 ECC*)

CONFERENCE PUBLICATIONS:

R.M. Voyles, J.D. Morrow, and P.K. Khosla, "Including Bias in Shape from Motion Calibration and Sensor Fusion," to appear *Proc. IEEE Multisensor Fusion and Integration Conf.*, Washington, DC, Dec 1996.

R.M. Voyles and P.K. Khosla, "Gesture-Based Programming, Part 1: A Multi-Agent Approach," in *Smart Engineering Systems Design: Neural Networks, Fuzzy Logic, and Evolutionary Programming*, Dagli, Akay, Chen, Fernandez, and Ghosh, eds., ASME Press.

R.M. Voyles, J.D. Morrow, and P.K. Khosla, "Gesture-Based Programming, Part 2: Primordial Learning," in *Smart Engineering Systems Design: Neural Networks, Fuzzy Logic, and Evolutionary Programming*, Dagli, Akay, Chen, Fernandez, and Ghosh, eds., ASME Press.

R.M. Voyles, Jr., G. Fedder and P.K. Khosla, "A Modular Tactile Sensor and Actuator Based on an Electrorheological Gel," in *Proceedings of 1996 IEEE International Conference on Robotics and Automation*, Minneapolis, MN, Apr. 1996.

R.M. Voyles, Jr., J.D. Morrow and P.K. Khosla, "Shape from Motion Approach to Rapid and Precise Force/Torque Sensor Calibration," in *Proceedings of ASME Dynamic Systems and Control Division*, 1995 ASME Winter Annual Meeting, San Francisco, CA, Nov. 1995.

R.M. Voyles, Jr. J.D. Morrow, and P.K. Khosla, "Shape from Motion Decomposition as a Learning Approach for Autonomous Agents," in *Proceedings of 1995 IEEE Conf. on Systems, Man, and Cybernetics*, Vancouver, B.C., Oct. 1995.

R.M. Voyles, Jr. and P.K. Khosla, "Multi-Agent Gesture Interpretation for Robotic Cable Harnessing," in *Proceedings of 1995 IEEE Conf. on Systems, Man, and Cybernetics*, Vancouver, B.C., Oct. 1995.

R.M. Voyles, Jr. and P.K. Khosla, "Tactile Gestures for Human/Robot Interaction," in *Proceedings of 1995 IEEE Conf. on Intelligent Robots and Systems*, Pittsburgh, PA, Aug. 1995.

R.M. Voyles, Jr., B.L. Stavnheim, and B. Yap, "Practical Electrorheological Fluid-Based Fingertips for Robotic Applications," in *Proceedings of 1989 IASTED International Symposium on Robotics and Manufacturing*, Santa Barbara, CA, Nov. 1989.

R.M. Voyles, "Host Control of a Stress Test Chamber via PC/AT," in *Proc. of 1987 IBM PC Symposium*.

R.M. Voyles, Jr., "Optical Detection of Bent Pins in a High Density Array," in *Proceedings of 1986 IEEE Southern Tier Technical Conference*, Binghamton, NY, Oct. 1986.

P.C. Krause, R.M. Voyles, Jr., and O. Wasynczuk, "Analysis and Simulation of a Brushless DC Servomotor," in *Proceedings of MotorCon 84*, 1984.

SUBMITTED PAPERS

R.M. Voyles, J.D. Morrow and P.K. Khosla, "Gesture-Based Programming: Shape from Motion Primordial Learning of Sensorimotor Primitives," submitted to *Journal of Robots and Autonomous Systems*.

R.M. Voyles, A. Agah, P.K. Khosla, and G.A. Bekey, "Tropism-Based Cognition for the Interpretation of Context-Dependent Gestures," submitted to *1997 IEEE International Conf. on Robotics and Automation.*, Albuquerque, NM, April, 1997.

R.M. Voyles and P.K. Khosla, "Can Calibration be Considered Learning?," submitted to *1997 IEEE International Conf. on Robotics and Automation.*, Albuquerque, NM, April, 1997.

TECHNICAL REPORTS:

R.M. Voyles, Jr. and P.K. Khosla, "Multi-Agent Perception for Human/Robot Interaction: A Framework for Intuitive Trajectory Modification," CMU-RI-TR-94-33, The Robotics Institute, Carnegie Mellon University, Sept., 1994.

R.M. Voyles, "Recommendation for Endicott's 64mm Module-Plugging Robot," IBM Technical Report

R.M. Voyles, "AML Compliant Motion Subroutine for the IBM 7565 Robot," IBM Technical Report

REFERENCES:

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