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RESEARCH INTERESTS

My research interests are in the areas of image processing, object tracking, and pattern recognition. My research to date has involved the integration of image segmentation and classification to provide a natural means for incorporating contextual information into the segmentation process. Additionally, my research in chaos-based image processing has been extremely fruitful and I am interested in extending it. I have also recently returned to my early work in evidential reasoning and now have been combining concepts from chaos theory, Dempster-Shafer theory, and Kalman filtering in developing integrated models of human cognition and as a baseline for artificial evidential reasoning.

EDUCATION

Michigan State University East Lansing, MI
PhD in Computer Science & Engineering May 2004
Advisor: Prof. Anil K. Jain
Dissertation: "*Segmentation, Classification, and Tracking of Humans for Smart Airbag Applications*"

University of Minnesota Minneapolis, MN
M.S. in the Management of Technology May 1994
Thesis: "*Development of a cost estimating expert system for printed circuit card design for Unisys Corporation*"

University of Michigan Ann Arbor, MI,
M.S. in Physics May 1984

Columbia University New York, NY
B.S. in Applied Physics May 1982

PUBLICATIONS

Book:

Application of Chaos and Fractals to Computer Vision, Bentham Scientific Press (manuscript submitted for review 12/13).

Book Chapters:

M. Farmer, "Application of the Wrapper Framework for Robust Image Segmentation for Object Detection and Recognition" in *Pattern Recognition*, InTech Press, 2009 (*invited*).

Journals:

M. Farmer, "Pre-attentive Processing for Video Surveillance Using Chaos Theory", *Journal of Applied Mathematics*, Sept. 2013.

Wehbe-Alamah, H., McFarland, M., Farmer, M., Call, C., Jones, M. "CultureCopia©: Developing a computer-based electronic transcultural simulation game based on Leininger's culture care theory", *Online Journal of Cultural Competence in Nursing and Healthcare*, 2(1), 29, 2012.

M. Farmer and S. Turner, "Multi-Media Classroom for Integrated In-Class and Distance Learning", *Academic Exchange Quarterly*, Spring 2008.

M. Farmer, "A Chaos Theoretic Analysis of Motion and Illumination in Video Sequences", *International Journal of Multimedia*, June 2007 (*invited*).

M. Farmer and A. K. Jain, "Smart Automotive Airbags: Occupant Classification and Tracking", *IEEE Trans. on Vehicular Technology*, Jan 2006.

M. Farmer and A. K. Jain, "A Wrapper-based Approach to Image Segmentation and Classification", *IEEE Trans. on Image Processing*, Dec. 2005.

Conferences:

E. G Freedman, M. Farmer, S. Yeary, M. Molleseau, & T. Hilgendorf, "Distinctiveness, emotion, and display size in change detection in faces". *Procs. of the 54th Annual Meeting of the Psychonomic Society*, Oct. 2013.

M. Farmer, "Illumination invariant intensity-based image registration using chaos theory", *Proc. IEEE Intl. Conf. on Acoustics, Speech, and Signal Processing*, May 2013.

M. Farmer, "A Comparison of a chaos-theoretic method for pre-attentive vision with traditional grayscale-based methods", *Proc. IEEE International Conference on Advanced Video and Signal based Surveillance*, 2011.

M. Farmer, "Accumulating evidence based on estimation theory and human psychology", *Proc. International Conference on Informatics and Control*, 2011.

- M. Farmer, "Application of evidence accumulation based on estimation theory and human psychology for automotive airbag suppression, *Proc. Special Session on Artificial Neural Networks and Intelligent Information Processing at the International Conference on Informatics and Control*, 2011.
- M. Farmer and W. Arthur, "Study of the phenomenology of DDOS network attacks in phase space", *Proc. International Conference on Security and Cryptography*, 2011.
- R. Fox and M. Farmer, "The effect of computer programming education on the reasoning skills of high school students", *Proc. International Conference on Frontiers in Education: Computer Science and Computer Engineering*, 2011.
- M. Farmer, "Quantization effects in applying chaos theory to the detection of motion in image sequences", *Proc. of IEEE International Conference on Digital Signal Processing*, 2009.
- M. Farmer, "Application of the wrapper framework for image object detection", *Proc. of IEEE International Conference on Pattern Recognition (ICPR)*, 2008.
- S. Turner and M. Farmer, "Assessment of student performance in an internet-based multimedia classroom", *Proc. International Conference on Frontiers in Education: Computer Science and Computer Engineering*, 2008.
- A. Del Amo and M. Farmer, "Aided image understanding system", *Proc. of IEEE North American Fuzzy Information Processing Society Conference*, 2008.
- M. Farmer and C. Yuan, "An algorithm for motion and change detection in image sequences based on chaos and information theory", *Proc. of SPIE Conference on Imaging Science and Technology*, vol. 6812, Image Processing: Algorithms and Systems VI, pp. 68120K-1-68120K-12, 2008.
- M. Farmer, "Chaotic phenomena from motion in image sequences", *Proc. of IEEE International Joint Conference on Neural Networks*, 2007.
- H. Rabiei, A. Mahloojifar and M. Farmer, "Providing context for tumor recognition using the wrapper framework", *Proc. of IEEE International Symposium on Biomedical Imaging*, 2007.
- M. Farmer, "Exploiting multi-fractal and chaotic phenomena of motion in image sequences: foundations", *Proc. of IEEE International Conference on Acoustic, Speech, and Signal Processing*, 2007.
- M. Farmer and J. Rieman, "Fusion of motion information with static classifications of occupant images for smart airbag applications", *Proc. of IEEE International Conference on Information Fusion*, 2006.
- M. Farmer and D. Shugars, "Application of genetic algorithms for wrapper-based image segmentation and classification", *Proc. of IEEE World Congress on Evolutionary Computation*, 2006. (Won Best Session Presentation)

M. Farmer, "Integrating temporal streams of image classifications using evidential reasoning for smart airbag applications", *Proc. of IEEE Conference on Electro-information Technology*, 2006.

M. Farmer, and S. Kittali, "The effects of motion and spatio-temporal non-uniform illumination on image-pair joint scattergrams", *Proc. of IEEE International Conference on Acoustics, Speech, and Signal Processing*, 2006.

M. Farmer, "Evidential reasoning for control of smart automotive airbag suppression", *Proc. of 7th IASTED Conference on Intelligent Systems and Control*, 2005. (Session Chair)

M. Farmer, S. Farmer, and A. K. Jain, "Non-Parametric feature selection for image-based airbag suppression", *International Conference on Applied Statistics*, 2005.

M. Farmer, X. Lu, H. Chen, and A. K. Jain, "Robust image motion estimation using Fusion", *Proc. of IEEE International Conference on Image Processing (ICIP)*, 2004.

M. Farmer and A. K. Jain, "A Wrapper-based approach to image segmentation and classification", *Proc. of IEEE International Conference on Pattern Recognition (ICPR)*, 2004.

M. Farmer and A. K. Jain, "Enhancing random mutation hill climbing feature selection with simulated annealing", *Proc. of IEEE International Conference on Pattern Recognition (ICPR)*, 2004.

M. Farmer and A. K. Jain, "Integrated segmentation and classification for automotive airbag suppression", *Proc. of IEEE International Conference on Image Processing (ICIP)*, 2003.

M. Farmer and A. K. Jain, "Occupant classification system for automotive airbag suppression", *Proc. of IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2003.

M. Farmer, R.L. Hsu, and A. K. Jain, "Interacting multiple model (IMM) Kalman filter for robust high-speed human motion tracking", *Proc. of IEEE International Conference on Pattern Recognition (ICPR)*, 2002.

U. S. PATENTS AWARDED

Number	Title	Date Awarded
6,856,694	Decision enhancement system for a vehicle safety restraint application	Feb. 2005
6,853,898	Occupant labeling for airbag-related applications	Feb. 2005
6,662,093	Image processing system for detecting when an airbag should be deployed	Dec 2003
6,577,936	Image processing system for estimating the energy transfer of an occupant into an airbag	June 2003
6,366,236	Neural network radar processor	April 2002
6,252,240	Vehicle occupant discrimination system and method	June 2001
6,198,998	Occupant type and position detection system	March 2001
6,085,151	Predictive collision sensing system	July 2000
6,028,548	Vehicle collision radar with randomized FSK waveform	February 2000
6,005,958	Occupant type and position detection system	December 1999
5,979,586	Vehicle collision warning system	November 1999
5,969,667	Radar system (technique for removing leakage signal from multi-beam mono-static radar))	October 1999
5,923,280	Vehicle collision radar with randomized FSK waveform	July 1999
5,800,262	Acoustic volume and torque weight sensor (continuation in part)	September 1998
5,685,772	Acoustic volume and torque weight sensor	November 1997
5,682,485	Deadlock avoidance for switched interconnect bus systems	October 1997
5,606,821	Smart weed recognition/classification system	March 1997
5,519,401	Programmed radar coordinate scan conversion	May 1996
5,343,204	Auto-focusing correction for rotational acceleration effects on inverse synthetic aperture radar images	August 1994

TEACHING EXPERIENCE

Graduate Courses	Advanced Software Engineering – CSC-580	University of Michigan-Flint
	This was a new course for the department, and is part of the new M.S. program. It was delivered in the cyber-classroom format (student on-the-fly determines if online or in-class). The course covers a broad range of topics within the field of Software Engineering, including Object Oriented Analysis and Design, Software Testing, an introduction to the Zachman Framework, Component-based development, patterns, and formal methods.	
	Independent Study – CSC-591	University of Michigan-Flint
	See CSC-391.	
	Computer Systems Architecture - CSC-565	University of Michigan-Flint
	This was a new course for the department, and is part of the new M.S. program. It was delivered in the cyber-classroom format (student on-the-fly determines if online or in-class). It covered issues associated with high performance processor architectures, including super-scalar and VLIW architectures, memory architectures, etc. I chose the textbook (Hennesey and Patterson), devised the syllabus and developed all course material.	
	Artificial Intelligence CSC-546	University of Michigan-Flint
	This was a new course for the department, and is part of the new M.S. program. This is a combined undergraduate and graduate course. It was delivered in the cyber-classroom format (student on-the-fly determines if online or in-class). The course covers the basics of classic AI, including Predicate Logic, Search, Expert Systems, as well as introducing the students to more modern topics such as Neural Nets, Fuzzy Logic, and Genetic Algorithms. The course also introduced advanced reasoning system such as Conceptual Graphs, Bayesian networks and Dempster-Shafer theory.	
Under-graduate Courses	Artificial Intelligence 446	University of Michigan-Flint
	This course was a Mixed Mode (partially online and partially in-class). The course covers the basics of classic AI at the undergraduate level, including Predicate Logic, Search, Expert Systems, as well as introducing them to modern topics such as Neural Nets, Fuzzy Logic, and Genetic Algorithms.	
	Software Engineering Capstone CSC-483	University of Michigan-Flint
	This is the senior capstone in Software Engineering. One of the capstone groups was the group of students that worked with me to develop the Information Management System for the FHEO program (see Grants and Awards in next section). Another very interesting capstone project was a complexity analyzer tool for C and MATLAB files for supporting the embedded software industry. The students developed a tool to compute Cyclomatic complexity, Halstead metrics, and other software quality metrics and present the results on directories of files. The program highlighted programs with possible quality issues. One group developed a	

	traffic flow and re-routing application for automobiles that was a finalist in the 2006 IEEE Computer Science International Design Competition.	
	Systems and Networking Capstone CSC-436	University of Michigan-Flint
	This is the senior capstone course for the systems and networking track of our program. The students work in groups of 3-5 students and develop a prototype system. One of the more interesting projects last semester was an networked poker game that allowed varying numbers of players to log onto the game to play.	
	Independent Study CSC-391	University of Michigan-Flint
	I have supported nearly twenty students to date on independent studies, over a variety of semesters. These studies have allowed students to both help me with ongoing research (the work on using information theory for motion segmentation, chaos modeling of network traffic), and also allowed them to explore areas of computer science that are not typically offered (designing an embedded system for a paintball gun system and developing a variety of computer games). The students' experiences for these courses were very positive.	
	Software Engineering II - CSC-383	University of Michigan-Flint
	As with Software Engineering I, this was a new course to the department. Software Engineering II covers the basics of software program management. We begin with the general quality systems such as CMMI and IEEE-12207, and then discuss the prescriptive and agile process models. We continue through all the aspects of management from project sizing, costing, scheduling, and risk management. I chose the textbook (Pressman), devised the syllabus, and developed all course material.	
	Software Engineering I - CSC-382	University of Michigan-Flint
	For Software Engineering this was a new course so I chose the textbook (Pressman), devised the syllabus and developed all course material. Software Engineering I covered methods for software requirements analysis, design, and testing for both structured and object oriented programming. We did an extensive amount of Use Case-based analysis. The course has a semester long project that the students use to apply the course materials.	
	Computer Architecture – CSC-365	University of Michigan-Flint
	Undergraduate Computer Architecture course covered all the basic concepts of computer organization. The course covers translation of assembly into machine instructions, execution of these on a sequential processor, a pipelined processor, and a super-scalar processor. Also covers the memory hierarchy in a modern micro-processor. For this course I used the Bryant & O'Halloran text. I developed the syllabus and all the course material.	
	Introduction to Programming - CSC-175	University of Michigan-Flint
	This is an introductory course in programming using standard C++. The Fall 2004 course used Microsoft's .NET environment, but was not well received by the students. I revamped the course, selected a new book, and	

	developed the new syllabus and all the required course materials. I also worked to standardize course content by providing syllabus to lecturers	
	Introduction to Unix - CSC-127	University of Michigan-Flint
	I developed the syllabus and all the course materials. My materials were later adopted by the adjunct lecturers as the standard material to use for the course.	
Industrial Courses		
	Co-developed 1-week course in Image Processing & Pattern Recognition	Eaton
	Worked with Prof. Anil Jain of Michigan State University to develop 2-day workshop for internal Eaton and external customer personnel during vision-based occupant sensing project. Course included one day on image processing topics and the second day on feature extraction, feature selection, and classification.	
Summer 1999	Co-developed and co-taught 1-week class on Software Methodology	ASL-Takata
	Developed a 1-week class covering Structured Analysis and Design, the Software Lifecycle, and current ISO and IEEE documentation standards. Course included both general technical information as well as application-related content (embedded software for airbag control).	
Fall 1994	Developed 3-month weekly lecture series on Systems Engineering	Unisys
	Offered a Systems Engineering course at Unisys. Defined course syllabus, solicited speakers for each week, and edited all course material. Topics included system requirements analysis, specification and design of various sensors, systems interconnect, and real-time software design, among many others. Attendance was nearly 100 students per week.	

GRANTS AND AWARDS

Fall 2012	Research and Creative Activities Award	\$2500.
	Was awarded university-wide award for recognition of accomplishments in research at the annual Faculty Convocation	
Summer 2007	Chaos Theoretic Phenomena for Image Motion Detection and Segmentation	\$13,940.
	Proposed and received a grant for the exploration of chaos-like phenomena in motion in image sequences, where the trajectory in phase space shows trajectories resembling chaotic trajectories. We also hypothesized that that a fractal measure for motion segmentation must possess two features: (i) be a local measure and (ii) can be estimated for finite data sets. Program successfully demonstrated these effects and resulted in one faculty paper and one faculty-student paper.	

Winter 2005	Information Management System for Flint Healthcare Employment Opportunities	\$14,000.
	Proposed and received a grant for the development of a web-based information management system to support a local non-profit organization in finding employment for residents in the Flint Enterprise Zone. The system consisted of a SQL Server database and a number of web pages and requisite middleware to connect the two. The system allows multiple users from five subordinate organizations of FHEO to log in and perform case management functions. The project is currently fielded and other local Flint non-profit organizations are expressing interest in tailoring the system to their specific needs. The project has 6 students working in a real-world software development project.	
Summer 2005	Inferring Intent of Human Behavior via Detection of Subtle Changes in Their Gait and Physical Pose	\$9,000.
	Awarded an internal grant from University of Michigan-Flint for research in the area of 3-D pose from motion. The goal of the grant was to employ two students and also work over the summer on research in human motion. I subsequently returned the grant due to a need to teach 3 courses over the Spring term when one faculty member resigned suddenly.	

PROFESSIONAL EXPERIENCE

9/2009 - present	Associate Professor - University of Michigan-Flint	Flint, MI
	Associate Professor in the Computer Science, Engineering and Physics Department. Responsible for a 3 course/semester load, as well as research and service. Served as the Director of the Graduate Program in Computer Science and Information Systems for more than five years. Grew program from 8 students to 110 students, and it is now the largest non-professional program in the university. Also ranked in the top-ten online programs for MS in Computer Science (http://www.bestcomputersciencedegrees.com/top/online-masters/). Developed Fast Track program to attract non-CS majors into the MS program. Initiated Game Development Track and a Web and Mobile Information Systems Track in the undergraduate program in cooperation with the Dept. of Communications and Visual Arts. Developed Health Informatics track within the graduate program in cooperation with School of Health Professionals.	
9/04-9/2009	Assistant Professor - University of Michigan- Flint	Flint, MI
	Assistant Professor in the Computer Science, Engineering Science, and Physics Department. Responsible for a 3 course/semester load, as well as research and service. I developed multiple new courses at both the undergraduate and graduate level in Software Engineering Computer Architecture, and Artificial Intelligence, as well as a course in Introduction to Programming. My research effort in the area of computer vision has continued with the completion of two journal articles as listed above. I	

	<p>have two directions of my current research: (i) chaos theory as a basis for isolating and removing illumination artifacts from video streams to improve motion segmentation, and (ii) shape-based image retrieval. Service work included: (i) Director of the Graduate Program, where I developed a joint Information Systems Track in cooperation with the School of Management, (ii) Developed Cyber-classroom for capturing the entire classroom experience on video for online course offerings, and (iii) Enrollment Subcommittee of the 2004/2005 Strategic Planning Committee, which devised plans for dramatic increases in enrollment over the next 5 years.</p>	
6/00-7/04	Innovation Center, Eaton Corp.	Southfield, MI
	<p>Lead development of real-time image processing software for automotive airbag suppression system. Defined overall system architecture (hardware and software), defined all required processing, and lead small research team to develop all algorithms. Researched all key areas of program including image segmentation, feature extraction and selection, and classification for occupant classification subsystem, as well as motion segmentation and unique implementation of Interacting Multiple Model (IMM) Kalman filtering. Effort involved all stages of development from prototyping of algorithms to porting to an embedded DSP. System was successfully integrated into two vehicle platforms and demonstrated to customer.</p>	
5/95-9/99	Automotive Systems Laboratory, Takata	Farmington Hills, MI
	<p>Lead development of collision prediction radar sensor system for automobiles that provided 180 degree warning to driver of impending collisions. Defined entire system including radar system requirements, processing hardware requirements, and software and algorithm requirements. Researched key algorithms including i) a Joint Probabilistic Data Association (JPDA) Kalman filter with Interacting Multiple Models (IMM) for tracking multiple ground targets (target size spanned motorcycles to rows of parked cars), and ii) a unique collision estimation algorithm that used Fuzzy Logic set membership generation for mapping the track vectors into vehicle behaviors, and Dempster-Shafer evidential reasoning to propagate the beliefs in the vehicle behaviors over time. System successfully completed proof of concept vehicle demonstrations.</p>	
5/88--5/95	Unisys Corp.	Eagan, MN
	<p>Chief Engineer for the Advanced Programs: Provided technical direction on multiple projects involving roughly 80 people at two locations. Organization's charter was to identify new market opportunities for commercializing defense technologies involving signal and image processing, track processing, embedded real-time software, and computer system architecture. Responsible for new product concept generation, project management, budgeting and scheduling, technical review, and securing external funding for development efforts. Agriculture product won ASAE product of the year award.</p> <p>Senior and then Lead Engineer for Airborne Systems: Managed two groups of 50 people across a number of internally and externally funded projects. One group developed technologies in the areas</p>	

	of signal processing, fiber optics, and multi-chip modules. Second group provided systems engineering expertise to all Airborne programs. Groups executed ongoing contracts while developing overall technology strategy for organization for future business and product upgrades. Technology group was responsible for securing external funding from government research laboratories. Lead technical development of Signal Processing R&D effort.	
6/86 – 5/88	Westinghouse Electric Corp.	Baltimore, MD
	Developed algorithms and performed system analysis for synthetic aperture radar (SAR) target imaging and recognition system. System was required to perform wide area search and then high-resolution imaging and classification of areas of potential high-value targets.	

MEMBERSHIPS

Senior Member IEEE (Computer Society and Signal Processing Society)
Senior Member ACM (Association for Computing Machines)

SERVICE

University Service

Director of the Graduate Program in Computer Science and Information Systems (2006-present)
Member of the College of Arts and Sciences Executive Committee (2011 and 2013 to present)
Member of the University-wide Academic Assessment Committee (2010-present and chair 2011 and currently)
Member and Chair of the University-wide Economic Status of the Faculty Committee (2010-2013)
Director of the Faculty Mentoring Program (2012)
Member of the University-wide Student Concerns Committee (2008-2011 and Chair in 2010)
Member of the University-wide Strategic Planning Committee (2010)
Member ad hoc committee to explore remuneration and responsibilities of chairs within College of Arts and Sciences (2010)
Member of Provost Search Committee (2009)
Mentor and presenter in the New Faculty Mentoring program (2009)
Chair of Computer Science Faculty Search (2008 and 2009)
Architect for the Computer Science Cyber-classroom (2005)
Member of the University-wide Strategic Planning Committee (2005)

Scholarly Reviewer for articles in the following journals:

IEEE Transactions on Image Processing
IEEE Transactions on Pattern Analysis and Machine Intelligence
IEEE Transactions on Vehicular Technology
IEEE Transactions on Evolutionary Computation
IEEE Transactions on Information Forensics & Security
IEEE Signal Processing Letters

Computer Vision and Image Understanding
Signal Processing: Image Communications
International Journal of Artificial Intelligence Tools
International Journal of Artificial Intelligence and Pattern Recognition
International Journal of Robotics and Automation
Sensors Magazine
Transportation Research, Part C: Emerging Technologies
IET Intelligent Transport Systems
International Journal of Information Technology & Decision Making
International Journal of Control, Automation and Systems
British Journal of Mathematics & Computer Science