

CARL R. CRAWFORD

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EMPLOYMENT

CURRENT **CSUPTWO**, Milwaukee, Wisconsin
Founder and President, July 2007 - Present

PREVIOUS **ANALOGIC CORPORATION**, Peabody, Massachusetts
Technical Vice President, Corporate Imaging Systems, May 1995 - June 2007

GENERAL ELECTRIC MEDICAL SYSTEMS, Milwaukee, Wisconsin
Senior Physicist, August 1983 - April 1995

ELSCINT, Haifa, Israel & Boston, Massachusetts
Senior Computer Scientist; Mathematician, October 1981 - July 1983

EDUCATION

GRADUATE **PURDUE UNIVERSITY**, West Lafayette, Indiana
Ph.D., Electrical Engineering, May 1977 - December 1981

PURDUE UNIVERSITY, West Lafayette, Indiana
M.S., Electrical Engineering, May 1976 - May 1977

UNDERGRADUATE **PURDUE UNIVERSITY**, West Lafayette, Indiana
B.S., Electrical Engineering, August 1973 - May 1976

ADJUNCT APPOINTMENTS

CURRENT **NORTHEASTERN UNIVERSITY**, Boston, Massachusetts
Adjunct Professor of Electrical and Computer Engineering
September 2007 - Present

PREVIOUS **UNIVERSITY OF WASHINGTON**, Seattle, Washington
Affiliate Professor of Radiology
May 1989 - April 1998

PROFESSIONAL

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|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MEMBERSHIP | IEEE, Fellow American Association of Physicists in Medicine (AAPM), Fellow Society of Photo-Optical Instrumentation Engineers (SPIE), Member |
| SERVICE | <i>IEEE</i> , Milwaukee Section Vice-chair: January 2009 - December 2009 Chair: January 2010 - December 2010 <i>IEEE Transactions on Medical Imaging</i> Associate Editor, December 1994 - March 2017 <i>IEEE Transactions on Computational Imaging</i> Associate Editor, July 2017 - October 2022 Senior Area Editor, October 2022 - present |
| TRAINING | General Electric Managerial Skills Development Course December, 1994 General Electric Project Leadership Course June, 1986 |

PERSONAL

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|-------------|---------------------------------------------|
| BIRTHDATE | August 29, 1956 |
| BIRTHPLACE | Milwaukee, Wisconsin |
| CITIZENSHIP | USA |
| LANGUAGES | Hebrew (conversational), French (beginning) |

* Additional information about Carl Crawford's inventions can be found in the following book: "Juice: The Creative Fuel That Drives World-Class Invention," Evan I. Schwartz, *Harvard Business School Press*, pp. 103-109, 2004. A reprint can be found at: www.csuptwo.com/juice.pdf.

WRITINGS

| | |
|----------------|---------------------------------------------------------------------|
| PATENTS | United States Issued: 89 International: 78 Total: 167 |
| SPECIFICATIONS | Analogic: 89 |
| REPORTS | Analogic: 411 General Electric: 187 Elscint: 43 Total: 641 |
| ARTICLES | Journal: 25 Conference: 20 Total: 45 |
| PRESENTATIONS | Conference: 67 Invited: 54 Total: 121 |

REVENUE GENERATION

| Project | Significance | Company | Role | Revenue (Millions) |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------|------------------------------|-------------------------------|
| Helical medical CT scanning | Revitalized CT market; 100% replacement of non-helical scanners. | GE Medical | Inventor | \$1,000 |
| Explosive detection algorithms. Reconstruction algorithms for multi-slice helical CT scanner. | World's first volumetric CT scanner for explosive detection | Analogic | Project engineer Inventor | \$600 |
| Full field-of-view upgrade of explosive detection scanner | Created 2nd-generation product allowing customer to capture international market | Analogic | Project engineer | \$100 |
| Transient noise suppressor for MRI scanner | Obviated expensive service calls | GE Medical | Inventor | \$50 |
| Helical scanning for portable CT scanner | Allowed deployment of low-tier scan in mid-tier | Analogic | Project engineer Inventor | \$20 |
| Three-dimensional display of CT data | Generated orthopedic application and increased sales of scanners | GE Medical | Project engineer Inventor | \$10 |
| Iterative bone correction for CT scanner | Improved bone-brain interface allowing more sales for neurological applications | Elscent | Project engineer Inventor | \$2 |
| Dual-energy explosive detection scanner | Reduced false alarm rate of scanners | Analogic | Project engineer Inventor | \$5 |
| Explosive detection scanner for carry-on luggage | Detection of explosives at portals | Analogic | Project engineer Inventor | \$5 |
| Total | | | | \$1,792 |

EMPLOYMENT HISTORY

CSUPTWO, Milwaukee, Wisconsin

July 2007 - Present

Csuptwo is a consulting practice specializing in medical imaging, Homeland Security, and product development.

Csuptwo specializes in the following modalities: computerized tomography (CT), magnetic resonance imaging (MRI), single photon emission tomography (SPECT), positron emission tomography (PET), and ultrasound imaging (U/S), dual energy imaging and automated threat detection algorithms based on computer aided detection (CAD).

Csuptwo specializes in the following aspects of product development: systems design, risk identification and mitigation, physics, signal and image processing, reconstruction algorithms and on-line implementations, and project leadership.

Present and past clients include (note that some clients do not want to be identified):

- Booz Allen Hamilton
- Department of Homeland Security
- GE Healthcare
- Inixtu
- Lawrence Livermore National Laboratory
- Mobius Imaging
- Northeastern University
- Philips Healthcare
- Quasars
- RefleXion Medical
- Samplify Systems
- Sandia National Laboratory
- Tribogenics
- Toshiba Medical Systems

ANALOGIC CORPORATION, Peabody, Massachusetts

May 1995 - June 2007

Employed as Technical Vice President, Corporate Imaging Systems, reporting primarily to Bernard M. Gordon, Chairman of the Board and Chief Executive Officer and John W. Wood, President and Chief Executive Officer. Responsible for physics, mathematics, systems engineering, image quality, system integration, reconstruction software, and service tools for medical and industrial CT scanners. Managed (four positions) of the following functions: Imaging Sciences for Medical CT, Imaging Sciences for Security, Reconstruction Software for Medical CT and Reconstruction Software for Security. Leadership included approximately twenty direct reports including both individual contributors and intermediate managers, mainly PhDs. In addition, provide technical support for mergers and acquisitions.

Standard deliverables for the products included: marketing and engineering requirement specifications (review for acceptable image quality); reconstruction requirement specifications (write and verify with scanner simulations); algorithm development; image quality predictions; scanner integration for first prototypes; reconstruction hardware (write specifications and choose hardware); on-line reconstruction software; verification and validation of on-line codes; support manufacturing and field service; automated image quality assessment; and automated threat (explosives, guns, knives) detection algorithms and software.

EMPLOYMENT HISTORY (continued)

The following CT scanners were developed:

- Medical CT Scanners
 - Portable (Philips, Tomoscan)
 - Mid-tier (Philips, Aura)
 - Low-cost (Siemens, Smile)
 - CT for PET/CT (Photodetection Systems)
 - 16-slice (Hitachi)
- Explosive Detection CT Scanners
 - Volumetric scanner (L-3 Communications, eXaminer)
 - Full field-of-view upgrade (L-3 Communications, eXaminer)
 - Dual energy model (L-3 Communications, eXaminer)
 - Carry-on inspection scanner (Analogic, Cobra)
 - Low-cost checked baggage (L-3 Communications, Argus)
 - Low-cost checked baggage (Perkin Elmer, Argus)
 - Large bore (Analogic, XLB)

The following is a summary of major research and development activities, both through his own technical work and through his leadership of direct and indirect reports from a wide range of technical disciplines.

Management:

- Program manager for full field-of-view upgrade to initial security scanner leading to approximately \$100 million in incremental revenue.
- Program manager for helical scanning version of portable CT scanner.
- Functional manager for imaging sciences and reconstruction software for medical and security.

Invention:

- 50 U.S. Patent Applications; 37 used in products.
- 411 technical reports.
- 89 product specifications.
- Helical scanning for asymmetric CT scanners; used in two models of medical CT scanners.
- Nutating slice reconstruction for cone-beam CT; used in explosive detection CT scanners.
- Automatic explosive detection algorithms; certified by FAA.
- Automatic image quality assessment for CT scanners.
- Dual energy CT algorithms foundation of two grants received by Analogic to develop next generation scanners.

Customer Utilization:

- Portable CT scanner's image quality exceeded expectations; sold as higher-tier scanner.
- Helical scanning increased market for portable CT scanner.
- Mid-tier CT scanner's image quality meets customer expectations.
- Explosive detection CT scanner certified with Analogic's automatic detection algorithms; over 600 scanners deployed.
- Full field-of-view upgrade enhanced reputation of original scanner allowing customer to dominate market.
- Dual energy scanner certified by the TSA with lowest false alarm rate in the industry.

EMPLOYMENT HISTORY (continued)

GE MEDICAL SYSTEMS, Milwaukee, Wisconsin

August 1983 - April 1995

Employed as a Senior Physicist in the computed tomography (CT) division of the Applied Science Laboratory through 1989. The following is a summary of major research and development activities, which have led to 31 United States patents.

- Developed methods for scanning with simultaneous patient translation (helical or spiral scanning), which doubled the scan rate and facilitated new protocols such as CT angiography. Generated an estimated \$1 billion in incremental revenue.
- Resolved the requirements for slip-ring architectures to enable the implementation of commercially and clinically viable scanners.
- Developed an interactive three-dimensional display package using a rapid prototyping process to meet aggressive cost and resource targets. Extended this technology to allow the mathematical disarticulation of joints.
- Developed a mathematical model of the spatial dependence of resolution and noise, which allowed cost-reduced data acquisition systems and one second scanners.
- Devised reconstruction algorithms for single photon emission computed tomography (SPECT) using fan-beam projections with a displaced center of rotation, allowing for the direct reconstruction of projections on a commercial scanner.
- Coded a graphics package and an image display program to support development of algorithms for the above projects.

Primary responsibilities, from the beginning of 1990, have been the algorithmic and systems aspects of magnetic resonance imaging (MRI) while working as a Senior Physicist in the MRI division of the Applied Science Laboratory. The following is a summary of key accomplishments.

- Identified the sources of radio frequency emissions (white pixels or spike noise), which increased the yield of a high speed scanner from zero to 100 percent. This was accomplished by assembling a five person team that disassembled a prototype scanner and determined usable component combinations. The work resulted in a design guide for future scanners.
- Invented and reduced to practice an inexpensive device to detect and eliminate rf emissions before they entered the scanner electronics, eliminating a \$3 million per year maintenance cost.
- Led a six member team to identify and reduce risk in a new high speed scanner, allowing the scanner to be shipped on time and fully featured.
- Developed a new method to improve the quality of partial Fourier imaging techniques, improving the quality of MR angiograms in regions of susceptibility such as the sinuses.
- Investigated a combined gradient and spin echo imaging (GRASE) sequence, which adds susceptibility contrast to Fast Spin Echo imaging.
- Managed a department research scanner that supports the development of new imaging protocols and hardware.

ELSCINT, Haifa, Israel

June 1982 - July 1983

Employed as a CT specialist reporting directly to the head of the research and development group in the radiology division. Handled mathematical aspects of the CT scanner in the framework of a consultant to the physics, software, and mechanical and electrical engineering groups. The following is a summary of major research and development activities, which have led to four United States patents.

EMPLOYMENT HISTORY (continued)

- Invented a new interpolation method for fan-beam CT resorting algorithms, to avoid paying patent royalties.
- Developed a high speed reprojection method using a modified back-projector so that a two-pass polychromatic correction algorithm could execute in clinically acceptable times.
- Wrote a cross-assembler for bit-slice processors, enabling faster development of micro-code for dedicated reconstruction computers.

ELSCINT INC., Boston, Massachusetts

October 1981 - June 1982

Worked in the CT research and development department. The following is a summary of major research and development activities, which led to one United States patent.

- Developed methods to reduce the level of image degradation caused by noncoplanarity.
- Directed a team that built a noncoplanar scanner from an existing coplanar machine in order to verify computer simulations of noncoplanarity.
- Simulated the data acquisition system in a cardiac CT scanner to determine its manufacturing tolerances.

SAN-TRON, Ipswich, Massachusetts

January 2003 - February 2005

Member of external advisory board having the objective to grow the business based on RF connector technology. Primary responsibilities include product development and management. Implemented an action-driven leadership program.

ULTRASONIC SYSTEMS, Amesbury, Massachusetts January 2000 - January 2001

Member of external advisory board having the objective to grow the business based on ultrasonic spray technology. Primary responsibilities include product development and management. The following is a summary of the present growth path.

- Expand the existing business in spray fluxing for OEM and retrofit customers.
- Develop new spraying applications.

PATENTS

- [1] Shimoni, Y., Netter, Z., and Crawford, C. R., "Equipment and methods of rearranging divergent beams," Assignee: Elscint Inc., United States: 4,570,224, February 11, 1986, France: 2,536,862, June 1, 1984, Netherlands: 8,304,091, June 18, 1984, Germany: 3,342,975, June 20, 1984, Israel: 70,212, March 31, 1987.
- [2] Crawford, C. R., and Reuveni, A., "A system of reprojecting images acquired by backprojection," Assignee: Elscint Ltd., United States: 4,626,991, December 2, 1986, Germany: 3,414,875, October 25, 1984, France: 2,544,939, October 26, 1984, Netherlands: 8,401,237, November 16, 1984, Israel: 71,561, March 31, 1987.
- [3] Crawford, C. R., "A system of reprojecting images using transform techniques," Assignee: Elscint Ltd., United States: 4,616,318, October 7, 1986, Germany: 3,420,576, February 7, 1985, France: 2,547,439, December 14, 1984, Netherlands: 8,401,684, January 2, 1985.
- [4] Crawford, C. R., and Freunlich, D., "An improved reprojection system," Assignee: Elscint Ltd., United States: 4,714,997, December 22, 1987, Germany: 3,420,575, January 17, 1985, France: 2,547,149, December 7, 1984, Netherlands: 8,401,739, January 2, 1985, Israel: 72,936, November 30, 1987.
- [5] Crawford, C. R., Barnea, D., Sohval, B., and Shimoni, Y., "System and methods for correcting noncoplanarity artifacts," Assignee: Elscint Ltd., United States: 4,578,753, March 25, 1986, Germany: 3,429,155, April 18, 1985, France: 2,551,211, March 1, 1985, Netherlands: 8,402,630, March 18, 1985, Israel: 72,663, October 31, 1988.
- [6] Gullberg, G. T., and Crawford, C. R., "Method and means of correcting for a shift in the center of rotation of a rotating fan beam CT system," Assignee: General Electric Medical Systems, United States: 4,703,424, October 27, 1987, Germany: 3,546,233, July 31, 1986.
- [7] Crawford, C. R., and Acharya, K. C., "Apparatus for reduction of filtration truncation errors," Assignee: General Electric Medical Systems, United States: 4,606,004, August 12, 1986, Germany: 3,509,777, September 26, 1985, Israel: 74,566, August 15, 1989.
- [8] Crawford, C. R., "Improved method and apparatus for back projection image reconstruction using virtual equi-spaced detectors," Assignee: General Electric Medical Systems, United States: 4,636,952, January 13, 1987.
- [9] Crawford, C. R., "Method and apparatus for imaging in the presence of multiple high density objects," Assignee: General Electric Medical Systems, United States: 4,709,333, November 24, 1987.
- [10] Gullberg, G. T., and Crawford, C. R., "Method and means of correcting for a shift in the center of rotation of a rotating fan beam CT system," Continuation in part of [6], Assignee: General Electric Medical Systems, United States: 4,812,983, March 14, 1989.
- [11] Crawford, C. R., and Lorensen, W. E., "Apparatus and method for improvement of 3D images derived from tomographic data," Assignee: General Electric Medical Systems, United States: 4,831,528, May 16, 1989. Europe: 316,135, May 17, 1989, Israel: 87,511, March 29, 1992.
- [12] Crawford, C. R., "Minimization of directed points generated in three-dimensional dividing cubes method," Assignee: General Electric Medical Systems, United States: 4,885,688, December 5, 1989, Europe: 318,292, May 31, 1989, Israel: 87,963, March 29, 1992, Canada: 1,315,902, April 6, 1993.
- [13] Crawford, C. R., Frazee, D. M., and Santos, E., "Rapid processing of three-dimensional graphical objects from tomographic data," Assignee: General Electric Medical Systems, United States: 4,868,748, September 19, 1989, Europe: 318,293, May 31, 1989, Israel: 87,964, May 5, 1992.
- [14] Crawford, C. R., "Image magnification to reduce rendering times of three-dimensional images," Assignee: General Electric Medical Systems, Europe: 318,291, May 31, 1989, Japan: 2,001,083, January 5, 1990, Israel: 87,966, July 15, 1992.
- [15] Crawford, C. R., Karr, S. G., Welles, K. B., O'Donnell, M., and Pelc, N. J., "Method and apparatus for coherent imaging system," Assignee: General Electric Medical Systems, United States: 5,005,419, April 9, 1991, Germany: 3,918,815, December 12, 1989.

PATENTS (continued)

- [16] Crawford, C. R., "Three-dimensional surface representation using connectivity method without leaks," Assignee: General Electric Medical Systems, United States: 4,905,148, February 27, 1990, Europe: 354,026, February 2, 1990.
- [17] Crawford, C. R., "Three-dimensional object removal via connectivity," Assignee: General Electric Medical Systems, United States: 4,903,202, February 20, 1990.
- [18] Crawford, C. R., "Three-dimensional images obtained from tomographic data using a variable threshold," Assignee: General Electric Medical Systems, United States: 4,914,589, April 3, 1990, Europe: 366,387, May 2, 1990, Israel: 366,387, March 25, 1992.
- [19] Crawford, C. R., "Three-dimensional images obtained from tomographic data having unequally spacing slices," Assignee: General Electric Medical Systems, United States: 4,953,087, August 28, 1990.
- [20] Crawford, C. R., "Three-dimensional images obtained from tomographic slices with gantry tilt," Assignee: General Electric Medical Systems, United States: 4,989,142, January 29, 1991.
- [21] Crawford, C. R., and Pelc, N. J., "Method for reducing motion induced artifacts in projection imaging," Assignee: General Electric Medical Systems, United States: 4,994,965, February 19, 1991, Europe: 370,341, May 30, 1990, Israel: 92,115, May 13, 1993.
- [22] Crawford, C. R., "Method for reducing skew image artifacts in helical projection imaging," Assignee: General Electric Medical Systems, United States: 5,046,003, September 3, 1991, Europe: 405,862, January 2, 1991, Canada: 2,010,136, December 20, 1990, Israel: 94,714, May 5, 1993.
- [23] Crawford, C. R., and Frazee, D. M., "Three dimensional disarticulation," Assignee: General Electric Medical Systems, United States: 5,150,427, September 22, 1992, Europe: 420,546, April 3, 1991, Canada: 2,014,907, March 29, 1992, Israel: 95,648, April 12, 1994.
- [24] King, K. F., Lonn, A. H. R., and Crawford, C. R., "Computerized tomographic image reconstruction method for helical scanning," Assignee: General Electric Medical Systems, United States: 5,270,923, December 14, 1993, Europe: 426,464, May 8, 1991, Canada: 2,021,624, May 3, 1991.
- [25] King, K. F., and Crawford, C. R., "Extrapolative reconstruction method for helical scanning," Assignee: General Electric Medical Systems, United States: 5,233,518, August 3, 1993, Europe: 428,348, May 22, 1991, Israel: 96,212, September 22, 1993.
- [26] King, K. F., and Crawford, C. R., "Method for helical scanning with a stationary detector using rebinning and splicing to create detector vertex projection sets," Assignee: General Electric Medical Systems, United States: 5,208,746, May 4, 1993, Europe: 430,550, June 5, 1991, Canada: 2,021,621, May 23, 1991.
- [27] Crawford, C. R., and King, K. F., "Method for fan beam helical scanning using rebinning," Assignee: General Electric Medical Systems, United States: 5,216,601, June 1, 1993, Europe: 430,549, June 5, 1991, Canada: 2,021,623, May 23, 1991.
- [28] Crawford, C. R., and King, K. F., "Method for reducing patient translation artifacts in tomographic imaging," Assignee: General Electric Medical Systems, United States: 5,170,346, December 8, 1992, Europe: 430,506, June 5, 1991, Israel: 96,318, September 22, 1993, Netherlands: 8,401,684, January 2, 1985.
- [29] King, K. F., and Crawford, C. R., "Compensation of computed tomography data for x-ray detector afterglow artifacts," Assignee: General Electric Medical Systems, United States: 5,265,013, November 23, 1993, Europe: 487,243, May 27, 1992, Canada: 2,048,782, May 20, 1992.
- [30] Toth, T. L., King, K. F., and Crawford, C. R., "Helical scanning computed tomography with tracking x-ray source," Assignee: General Electric Medical Systems, United States: 5,090,037, February 18, 1992, Europe: 487,245, May 5, 1992, Canada: 2,048,741, May 20, 1992, China: 1,061,524, June 3, 1992.

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- [31] Crawford, C. R., "Motion artifact reduction in projection imaging," Assignee: General Electric Medical Systems, United States: 5,251,128, October 5, 1993, Germany: 4,137,652, May 21, 1992, Great Britain: 2,250,164, May 27, 1992.
- [32] Hu, H., Crawford, C. R., Pfoh, A. H., and Hsieh, J., "Tomographic image reconstruction using cross-plane rays," Assignee: General Electric Medical Systems, United States: 5,396,528, March 7, 1995, Europe: 520,778, December 30, 1992.
- [33] Toth, T. L., Crawford, C. R., and King, K. F., "Deconvolution filter for CT system," Assignee: General Electric Medical Systems, United States: 5,361,291, November 1, 1994, Europe: 543,626, May 26, 1993.
- [34] Toth, T. L., King, K. F., and Crawford, C. R., "Helical scanning computed tomography apparatus with constrained tracking of the x-ray source," Assignee: General Electric Medical Systems, United States: 5,224,136, June 29, 1993.
- [35] Crawford, C. R., and Ritchie, C. J., "Localized motion artifact reduction in projection imaging," Assignee: General Electric Medical Systems, United States: 5,287,276, February 15, 1994.
- [36] Crawford, C. R., and Ritchie, C. J., "Correction of CT attenuation data using fan beam reprojections," Assignee: General Electric Medical Systems, United States: 5,438,602, August 1, 1995.
- [37] Crawford, C. R., Dallapiazza, D. G., Eash, M. G., Pelc, N. J., Small, D., Souza, S. P., and Stormont, R. S., "Detection and elimination of wide bandwidth noise in MRI signals," Assignee: General Electric Medical Systems, United States: 5,525,906, June 11, 1996.
- [38] Crawford, C. R., Ruth, C. R., Bachilov, Y., and Deych, R., "Multi-processor afterglow artifact correction filter for use with computed tomography scanners," Assignee: Analogic Corporation, United States: 5,644,610, July 1, 1997, Germany: 19781844.7-35, March 6, 2003, Holland: 1,006,359, February 15, 2000.
- [39] Ruth, C. R., Dobbs, J. M., and Crawford, C. R., "Method and apparatus for helical computed tomography scanning with asymmetric detector system," Assignee: Analogic Corporation, United States: 5,828,718, October 27, 1998, Taiwan: 101,512, February 11, 1999, Netherlands: 1,007,611, July 21, 1999, Japan: 3,609,425, October 22, 2004, China: ZL 97180040.5, September 8, 2004.
- [40] Larson, G., Ruth, C. C., and Crawford, C. R., "Nutating slice CT image reconstruction apparatus and method," Assignee: Analogic Corporation, United States: 5,802,134, September 1, 1998, Japan: 3,547,455, April 23, 2004.
- [41] Urchuk, S. N., Ruth, C. C., and Crawford, C. R., "Apparatus and method for computed tomography scanning using halfscan reconstruction with asymmetric detector system," Assignee: Analogic Corporation, United States: 5,848,117, December 8, 1998, Taiwan: 104,424, June 1, 1999, Japan: 3,660,586, March 25, 2005.
- [42] Schafer, D. A., Ruth, C. C., and Crawford, C. R., "Air Calibration Scan for Computed Tomography Scanner with Obstructing Objects," Assignee: Analogic Corporation, United States: 5,949,842, September 7, 1999.
- [43] Ruth, C. C., Crawford, C. R., and Weedon, H. J., "Computed Tomography Scanning Apparatus and Method with Temperature Compensation for Dark Current Offsets," Assignee: Analogic Corporation, United States: 5,970,113, October 19, 1999.
- [44] Ruth, C. C., and Crawford, C. R., "Computed Tomography Scanning Target Detection Using Non-Parallel Slices," Assignee: Analogic Corporation, Japan: 3585835, August 13, 2004, United States: 5,909,477, June 1, 1999.
- [45] Crawford, C. R., and Ruth, C. C., "Computed Tomography Scanning Target Detection Using Target Surface Normals," Assignee: Analogic Corporation, United States: 5,901,198, May 4, 1999.

PATENTS (continued)

- [46] Bailey, E. M., Crawford, C. R., Greenberg, A. I., and Ruth, C. C., "Parallel Processing Architecture for Computed Tomography Scanning System Using Non-Parallel Slices," Assignee: Analogic Corporation, Japan: 3585835, August 13, 2004, United States: 5,887,047, March 23, 1999.
- [47] Crawford, C. R., and Ruth, C. C., "Computed Tomography Scanning Apparatus and Method for Generating Parallel Projections Using Non-Parallel Slice Data," Assignee: Analogic Corporation, Japan: 3585835, August 13, 2004, United States: 5,881,122, March 9, 1999.
- [48] Gordon, B. M., Bailey, E. M., Schafer, D. A., Ruth, C. C., and Crawford, C. R., "Computed Tomography Scanning Apparatus and Method Using Adaptive Reconstruction Window," Assignee: Analogic Corporation, United States: 6,256,404, July 3, 2001.
- [49] Hiraoglu, M., Bechwati, I. M., Simanovsky, S., and Crawford, C. R., "Apparatus and Method for Detecting Sheet Objects in Computed Tomography Data," Assignee: Analogic Corporation, United States: 6,111,974, August 29, 2000.
- [50] Simanovsky, S., Hiraoglu, M., Bechwati, I. M., and Crawford, C. R., "Apparatus and Method for Eroding Objects in Computed Tomography Data," Assignee: Analogic Corporation, United States: 6,075,871, June 13, 2000.
- [51] Bechwati, I. M., Hiraoglu, M., Simanovsky, S., and Crawford, C. R., "Apparatus and Method for Combining Related Objects in Computed Tomography Data," Assignee: Analogic Corporation, United States: 6,128,365, October 3, 2000.
- [52] Simanovsky, S., Hiraoglu, M., Bechwati, I. M., and Crawford, C. R., "Apparatus and Method for Detecting Sheet Objects in Computed Tomography Data," Assignee: Analogic Corporation, United States: 6,026,143, February 15, 2000.
- [53] Bechwati, I. M., Hiraoglu, M., Simanovsky, S., and Crawford, C. R., "Apparatus and Method for Classifying Objects in Computed Tomography Data Using Density Dependent Mass Thresholds," Assignee: Analogic Corporation, United States: 6,076,400, June 20, 2000.
- [54] Bechwati, I. M., Hiraoglu, M., Simanovsky, S., and Crawford, C. R., "Apparatus and Method for Correcting Object Density in Computed Tomography Data," Assignee: Analogic Corporation, United States: 6,108,396, August 22, 2000.
- [55] Simanovsky, S., Hiraoglu, M., Bechwati, I. M., and Crawford, C. R., "Apparatus and Method for Density Discrimination of Objects in Computed Tomography Data Using Multiple Density Ranges," Assignee: Analogic Corporation, United States: 6,078,642, June 20, 2000.
- [56] Hiraoglu, M., Bechwati, I. M., Simanovsky, S., and Crawford, C. R., "Apparatus and Method for Detection of Liquids in Computed Tomography Data," Assignee: Analogic Corporation, United States: 6,026,171, February 15, 2000.
- [57] Hiraoglu, M., Bechwati, I. M., Simanovsky, S., and Crawford, C. R., "Apparatus and Method for Optimizing Detection of Objects in Computed Tomography Data," Assignee: Analogic Corporation, United States: 6,272,230, August 7, 2001.
- [58] Hiraoglu, M., Bechwati, I. M., Simanovsky, S., and Crawford, C. R., "Multiple-Stage Apparatus and Method for Detecting Objects in Computed Tomography Data," Assignee: Analogic Corporation, United States: 6,035,014, March 7, 2000.
- [59] Simanovsky, S., Hiraoglu, M., Bechwati, I. M., and Crawford, C. R., "Computed Tomography Apparatus and Method for Classifying Objects," Assignee: Analogic Corporation, United States: 6,317,509, November 13, 2001.
- [60] Simanovsky, S., Hiraoglu, M., Bechwati, I. M., and Crawford, C. R., "Apparatus and Method for Detecting Objects in Computed Tomography Data Using Erosion and Dilation of Objects," Assignee: Analogic Corporation, United States: 6,067,366, May 23, 2000.
- [61] Urchuk, S. N., and Crawford, C. R., "Apparatus and method for calibrating detectors in a computed tomography scanner," Assignee: Analogic Corporation, United States: 6,148,057, November 14, 2000.

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- [24] Martz, H. E., and Crawford, C. R., "Thoughts on Technology Effectiveness for Passenger Rail," presented at the U.S. Government Accountability Office session on "Explosives Detection Technologies That Could Help Protect Passenger Rail," National Academies of Sciences, Washington, DC, August 12, 2009.
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- [29] Crawford, C. R., "Current Trends and Future of Medical Imaging," presented at GE Healthcare, Milwaukee, Wisconsin, February 21, 2013.
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- [38] Crawford, C. R., "Explosive Detection for Aviation Security Using Technology Derived from Medical Imaging," Electrical Engineering and Computer Science Department, Purdue University, West Lafayette, Indiana, April 7, 2016.
- [39] Crawford, C. R., "Impact of Captivated Medicine on Medical Imaging," presented at the 37th Annual Great Lakes Biomedical Conference, Digital Healthcare: Opportunities and Challenges, Waukesha, Wisconsin, April 6, 2017.
- [40] Crawford, C. R., "Risk Tradeoffs in Technology Design," presented at the Aviation Security Futures Workshop, Washington, DC, September 27, 2017.

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- [42] Crawford, C. R., "Awareness and Localization of Explosives Related Threats (ALERT) COE," presented at "Transportation and Critical Infrastructure Panel," at the "U.S. Department of Homeland Security, Centers of Excellence Summit 2018," Michael Silevitch, moderator, George Mason University, Arlington, VA, May 30, 2018.
- [43] Crawford, C. R., "Impact of Capitalized Medicine on Medical Imaging," presented at GE Healthcare, Milwaukee, Wisconsin, September 12, 2018.
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- [45] Crawford, C. R., "Personal Experiences with Protecting a Specific Soft Target," presented at the U.S. Department of Homeland Security Centers of Excellence Summit, Homeland Security Challenges: Evolving Threats and Dynamic Solutions, George Mason University, Arlington, Virginia, August 1, 2019.
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- [47] Crawford, C. R., "Achieving and Relaxing The Assumptions Posed by Cormack," presented at the Conference on Modern Challenges in Imaging In the Footsteps of Allan MacLeod Cormack On the Fortieth Anniversary of his Nobel Prize, Tufts University, Medford, Massachusetts, August 5, 2019.
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- [49] Crawford, C. R., "How medical computed tomography improved since its inception in the 1960s," Milwaukee School of Engineering, Milwaukee, Wisconsin, February 3, 2020.
- [50] La Riviere, P. J., and Crawford, C. R., "From EMI to AI: a brief history of commercial CT reconstruction algorithms," Center for Nondestructive Characterization, Lawrence Livermore National Laboratory, December 7, 2021.
- [51] Crawford, C. R., "Historical Perspective of the Use of Computed Tomography (CT) for Medical Imaging and Aviation Security and the Impact of Artificial Intelligence," presented at the Milwaukee School of Engineering (MSOE), Milwaukee, Wisconsin, February 4, 2022.
- [52] La Riviere, P. J., and Crawford, C. R., "From EMI to AI: a brief history of commercial CT reconstruction algorithms," presented at the Advanced Development for Security Applications, Twenty Fifth Workshop (ADSA25), "Protecting Surface Transportation and Other Soft Targets," Northeastern University, Boston, May 4, 2022.
- [53] Crawford, C. R., "Optimization of Security for Soft Targets," presented at Reconnect 2022: Optimization, The Center for Discrete Mathematics and Theoretical Computer Science Rutgers University, Princeton, New Jersey, June 16, 2022.
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CONFERENCE PRESENTATIONS (continued)

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- [33] King, K. F., and Crawford, C. R., "CT Scanning With Simultaneous Patient Translation," presented at the "76th Scientific Assembly of The Radiology Society of North America," Chicago, Illinois, November 25 - 30, 1990. Abstract appeared in *Radiology*, Vol. 177(P), November 1990, p. 108.
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- [62] Crawford, C. R., "Development, testing and deployment of distributed and orthogonal threat detection equipment," presented at the Fourth Annual DHS University Network Summit, sponsored by, U.S. Department of Homeland Security, Science and Technology Directorate, Office of University Programs, Washington, District of Columbia, March 12, 2010.

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- [63] Crawford, C. R., Beaty, J. S., Castanon, D. A., and Martz, H. E., "Facilitation of Third-party Development of Advanced Algorithms for Explosive Detection Using Workshops and Grand Challenges," presented at the Tenth Annual IEEE International Conference on Technologies for Homeland Security (IEEE HST '10), Boston, MA, November 8, 2010.
- [64] Crawford, C. R., Beaty, J. S., Castanon, D. A., and Martz, H. E., "Facilitation of Third-party Development of Advanced Algorithms for Explosive Detection Using Workshops and Grand Challenges," presented at the Fifth Annual DHS University Network Summit, sponsored by, U.S. Department of Homeland Security, Science and Technology Directorate, Office of University Programs, Washington, District of Columbia, March 30, 2011.
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- [66] Crawford, C. R., "Bulk Explosives Detection-X-Ray and Millimeter Wave Radar Systems," presented at the 2015 IEEE International Symposium on Technologies for Homeland Security (IEEE HST '15), Boston, MA, April 14, 2015.
- [67] Gaikwad, B., Patra, A., Crawford, C., and Miller, E., "Self-supervised anomaly detection and a new benchmark for x-ray cargo images," presented at the IEEE International Conference on Image Processing, Abu Dhabi, UAE, October 27-30, 2024, 2024.ieeeicip.org.

WORKSHOP COORDINATION

- [1] Crawford, C. R., Martz, H. E., and Silevitch, M., Algorithm Development for Security Applications, First Workshop (ADSA01), "Application to the checkpoint," Northeastern University, Boston, April 23-24, 2009.
- [2] Crawford, C. R., Martz, H. E., and Silevitch, M., Algorithm Development for Security Applications, Second Workshop (ADSA02), "Implementing Grand Challenges," Northeastern University, Boston, October 7-8, 2009.
- [3] Crawford, C. R., Rappaport, C., and Silevitch, M., Algorithm Development for Security Applications Third Workshop (ADSA03), "Application to Advanced Imaging Technology (Whole Body Imaging)," Northeastern University, Boston, April 27-28, 2010.
- [4] Crawford, C. R., Martz, H. E., and Silevitch, M., Algorithm Development for Security Applications, Fourth Workshop (ADSA04), "Reconstruction Algorithms for CT-Based Explosive Detection Equipment," Northeastern University, Boston, October 5-6, 2010.
- [5] Crawford, C. R., Martz, H. E., and Silevitch, M., Algorithm Development for Security Applications, Fifth Workshop (ADSA05), "Fusing Orthogonal Technologies," Northeastern University, Boston, May 3-4, 2011.
- [6] Crawford, C. R., Martz, H. E., and Silevitch, M., Algorithm Development for Security Applications, Sixth Workshop (ADSA06), "Development of Fused Explosive Detection Equipment with Specific Application to Advanced Imaging Technology," Northeastern University, Boston, November 8-9, 2011.
- [7] Crawford, C. R., Martz, H. E., and Silevitch, M., Algorithm Development for Security Applications, Seventh Workshop (ADSA07), "CT-Based Explosive Detection Equipment: Improved Reconstruction and Accelerated Deployment," Northeastern University, Boston, May 15-16, 2012.
- [8] Crawford, C. R., Martz, H. E., and Silevitch, M., Algorithm Development for Security Applications, Eighth Workshop (ADSA08), "Automated Threat Recognition (ATR) Algorithms for Explosion Detection Systems," Northeastern University, Boston, October 24-25, 2012.
- [9] Crawford, C. R., Martz, H. E., and Silevitch, M., Algorithm Development for Security Applications, Ninth Workshop (ADSA09), "New Methods for Explosive Detection for Aviation Security," Northeastern University, Boston, October 22-23, 2013.
- [10] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Tenth Workshop (ADSA10), "Explosives Detection in Air Cargo," Northeastern University, Boston, May 6-7, 2014.
- [11] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Eleventh Workshop (ADSA11), "Explosives Detection in Air Cargo - Part II," Northeastern University, Boston, November 4-5, 2014.
- [12] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Twelfth Workshop (ADSA12), "Screening of personnel and divested items at the checkpoint," Northeastern University, Boston, May 12-13, 2015.
- [13] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Thirteenth Workshop (ADSA13), "Screening of personnel and divested items at the checkpoint - Part 2," Northeastern University, Boston, October 28-29, 2015.
- [14] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Fourteenth Workshop (ADSA14), "Development and Deployment of Fusible Technologies for the Checkpoint," Northeastern University, Boston, May 10-11, 2016.
- [15] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Fifteenth Workshop (ADSA15), "Next Generation Screening Technologies and Processes for the Checkpoint," Northeastern University, Boston, November 15-16, 2016.
- [16] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Sixteenth Workshop (ADSA16), "Addressing the Requirement for Different Stakeholders in Transportation Security," Northeastern University, Boston, May 2-3, 2017.

WORKSHOP COORDINATION (continued)

- [17] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Seventeenth Workshop (ADSA17), "Systems Engineering Of Aviation Security Systems," Northeastern University, Boston, October 17-18, 2017.
- [18] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Eighteenth Workshop (ADSA18), "Collection and Use of Metadata for Improving Aviation Security Systems," Northeastern University, Boston, May 15-16, 2018.
- [19] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Nineteenth Workshop (ADSA19), "Rapid Response to an Adapting Adversary," Northeastern University, Boston, October 16-17, 2018.
- [20] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Twentieth Workshop (ADSA20), "Design, Development, Testing, Deployment and Operation of Effective Systems," Northeastern University, Boston, May 15-16, 2019.
- [21] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Twenty First Workshop (ADSA21), "Effective Integrated Systems," Northeastern University, Boston, November 5-6, 2019.
- [22] Crawford, C. R., Martz, H. E., Merzbacher, M., and Silevitch, M., Advanced Development for Security Applications, Twenty Second Workshop (ADSA22), "Reducing Operator Cognitive Load in Aviation Security," Northeastern University, Boston, November 17, 2020, November 24, 2020, December 1, 2020, and December 8, 2020.
- [23] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Twenty Third Workshop (ADSA23), "Autonomous Security Systems," Northeastern University, Boston, May 4, May 11, and May 25, 2021.
- [24] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Twenty Fourth Workshop (ADSA24), "Advancing Collaboration for Enhanced Security," Northeastern University, Boston, October 5-6, 2021.
- [25] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Twenty Fifth Workshop (ADSA25), "Protecting Surface Transportation and Other Soft Targets," Northeastern University, Boston, May 3-4, 2022. Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Twenty Sixth Workshop (ADSA26), "Reducing the Lethality of Attacks on Soft Targets," Northeastern University, Boston, November 31, 2022 and December 1, 2022.
- [26] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Twenty Seventh Workshop (ADSA27), "Implementation and Deployment of Situational Awareness Platforms for Protecting Soft Targets," Northeastern University, Boston, November 14-15, 2023.
- [27] Crawford, C. R., Martz, H. E., and Silevitch, M., Advanced Development for Security Applications, Twenty Eighth Workshop (ADSA28), "Building Effective Security for Soft Targets," Northeastern University, Boston, November 13-14, 2024.
- [28] Crawford, C. R., Taylor, D., and Silevitch, M., Customs and Border Protection - Advanced Developments Encompassing Processes and Technologies: Workshop 1 (ADEPT01), "Customs and Border Protection," Northeastern University, Boston, June 20-21, 2018.
- [29] Crawford, C. R., Taylor, D., and Silevitch, M., Customs and Border Protection - Advanced Developments Encompassing Processes and Technologies: Workshop 2 (ADEPT02), "Advanced Development and Processes for Tomorrow," Northeastern University, Boston, July 17-18, 2019.
- [30] Crawford, C. R., Taylor, D., and Silevitch, M., Customs and Border Protection - Advanced Developments Encompassing Processes and Technologies: Workshop 3 (ADEPT03), "Creating Effective Engagements with CBP," Northeastern University, Boston, November 16-17, 2021.

WORKSHOP COORDINATION (continued)

- [31] Crawford, C. R., Martz, H. E., Silevitch, M., and Taylor, D., Customs and Border Protection - Advanced Developments Encompassing Processes and Technologies: Workshop 4 (ADEPT04), "Case Studies for Enhancing Interdiction of Contraband," Northeastern University, Boston, August 17-18, 2022.
- [32] Crawford, C. R., Martz, H. E., Silevitch, M., and Taylor, D., Customs and Border Protection - Advanced Developments Encompassing Processes and Technologies: Workshop 5 (ADEPT05), "Development and Deployment of Algorithms for Enhancing the Interdiction of Contraband," Northeastern University, Boston, June 7-8, 2023.
- [33] Crawford, C. R., Martz, H. E., and Pien, H., "Segmentation of Objects from Volumetric CT Data," Northeastern University, Boston, December 8, 2011.
- [34] Crawford, C. R., Karl, W. C., and Martz, H. E., "Research and Development of Reconstruction Advances in CT-Based Object Detection Systems," Northeastern University, Boston, October 24, 2013.
- [35] Crawford, C. R., Castanon, D. A., Karl, W. C., and Martz, H. E., "Advances in Automatic Target Recognition (ATR) for CT-Based Object Detection systems," Northeastern University, Boston, February 28, 2015.
- [36] Crawford, C. R., Castanon, D. A., Martz, H. E., Beaty, J., and Silevitch, M., "Research and Development of Adaptive Automatic Target Recognition for CT-Based Object Detection Systems," Northeastern University, Boston, March 17, 2018.
- [37] Crawford, C. R., Castanon, D. A., Martz, H. E., Beaty, J., and Silevitch, M., "Research and Development of Systems for Tracking Passengers and Divested Items at the Checkpoint," Northeastern University, Boston, March 17, 2018.
- [38] Crawford, C. R., Martz, H. E., and Whitehead, S., "Science review panel on developing and validating simulants for commercial, military and home made explosives," Department of Homeland Security, Washington, DC, March 8-9, 2010.
- [39] Crawford, C. R., Bulat, E., Taylor, D., and Todorov, V. "Command Center Enhancements Workshop," Long Beach, CA, July 12-13, 2022.

ACADEMIC HISTORY

NORTHEASTERN UNIVERSITY, Boston, Massachusetts September 2007 - Present

As an adjunct professor, collaborated with the Department of Electrical and Computer Engineering on medical imaging and threat detection. Coordinate workshops on algorithm development for security applications. Support initiatives that are recommended at the workshops.

TEMPLE UNIVERSITY, Philadelphia, Pennsylvania January 1996 - April 1998

As an adjunct professor, collaborated with the Department of Diagnostic Imaging on the clinical and technical aspects of CT and MRI. The following is a summary of primary activities.

- Investigated artifacts in CT and MR images and their diagnostic pitfalls in neuroimaging.

UNIVERSITY OF WASHINGTON, Seattle, Washington May 1989 - April 1998

As an adjunct professor, collaborated with the Department of Radiology on clinical aspects of CT. The following is a summary of primary activities.

- Developed new scanning protocols and correction algorithms to minimize the affects of patient motion. The protocols were adopted with the advent of helical scanning and sub-second scanners.
- Supervised one doctorate student's work on the reduction of motion artifacts in CT.

MEDICAL COLLEGE OF WISCONSIN, Milwaukee, WI July 1990 - January 1996

As an adjunct professor, collaborated with the Departments of Radiology and Biophysics. The following is a summary of primary areas of collaboration.

- Organized a journal club for MRI, which identified new technology for GE Medical Systems.
- Served on the academic steering committee.

PURDUE UNIVERSITY, West Lafayette, Indiana August 1976 - October 1981

Did research in the Ultrasonics Information Processing Laboratory under the direction of Professor Avinash C. Kak. The following is a summary of key research accomplishments.

- Wrote thesis: Multipath artifacts in ultrasonic transmission tomography
- Designed, constructed, and programmed a multi-processor ultrasonic transmission tomographic scanner and investigated the sources of image degradation in ultrasonic tomography.
- Developed methods to reduce the influence of multipath artifacts in ultrasound tomography, which made attenuation images equivalent to time-of-flight images.
- Wrote a graphics package for a network of minicomputers running the UNIX operating system, which allowed interactive development of signal processing algorithms [documentation].
- Taught courses in Finite State Theory and in Digital Signal Processing.
- Wrote a C cross-compiler to support the development of code for the ultrasound scanner.

ACADEMIC HISTORY (continued)

OHIO NUCLEAR, Cleveland, Ohio

May 1979 - July 1980

Employed as a consultant while working on graduate studies at Purdue University. The following is a summary of the consulting.

- Developed reconstruction algorithms for a translate-continuous-rotate tomographic scanner, to reduce the scan times of second generation CT scanners.

G. D. SEARLE, Chicago, Illinois

January 1976 - December 1977

Employed as a consultant while working on graduate studies at Purdue University. The following is a summary of the consulting.

- Researched the influence of detector and source sampling in CT reconstruction algorithms and showed that aliasing was the source of streak artifacts.
- Showed how to overcome filter aliasing, which allowed for quantitative CT.

HUGHES AIRCRAFT, Los Angeles, California

May 1976 - August 1976

Worked as a summer employee prior to beginning graduate studies at Purdue University. The following is a summary of major accomplishments.

- Designed error detection hardware and the monitor interface card for the programmable signal processor used in the F-18 radar.

IBM, Rochester, Minnesota

June 1975 - August 1975

Worked as a summer employee while working towards a B.S. at Purdue University. The following is a summary of major accomplishments.

- Wrote software to create and edit data bases used to support automated circuit board assembly equipment, which obviated manual manipulation of the data bases on key punches.
- Wrote step-and-repeat software for numerical controlled drill machines, which automated the development of new manufacturing setups.

MASTERS THESIS SUPERVISION

- [1] Weinstein, Ira D., "Algorithms for the Display of Surfaces in Three Dimensional Medical Computerized Tomography Data," Master of Science, Department of Electrical Engineering, Marquette University, Milwaukee, Wisconsin, May, 1986.
- [2] Santos, Enrique, "Implementation of three-dimensional display algorithms for the display of three-dimensional computerized tomographic images on a large minicomputer," Master of Science, Department of Electrical Engineering, Marquette University, Milwaukee, Wisconsin, July, 1986.
- [3] Kohli, James F., "On the estimation of magnetic resonance spectra using various methods," Master of Science, Department of Electrical Engineering, Marquette University, Milwaukee, Wisconsin, May, 1990.

DOCTORATE THESIS SUPERVISION

- [1] Ritchie, Cameron J., "Methods for reducing motion artifacts in computed tomography scans of the chest," Doctor of Philosophy, Department of Bioengineering, University of Washington, Seattle, Washington, September, 1993.

COMMITTEE

- [1] Hyland, S., Bitner, C., Cooks, G., Crawford, C., Garrick, J., Gatsonis, C., Glover, G., Lele, S., Martz, H., and Meeker, W., "Engineering Aviation Security Environments - Reduction of False Alarms in Computed Tomography- Based Screening of Checked Baggage," Committee on Engineering Aviation Security Environments - False Positives from Explosive Detection Systems, National Research Council of the National Academies, July 19, 2013, [final report].

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|-------------------------|--------------------------------------------------------------------------------------|
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| Source | Transportation Security Administration, Department of Homeland Security |
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| Principal Investigators | Carl R. Crawford and Zhengrong Ying, Analogic |
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