Resume for Thomas H. Kerr III

NAME	ADDRESS	TELEPHONE
Thomas Henderson Kerr III	11 Paul Revere Rd Lexington, MA 02421-6632	(781) 862-5870 (Home) (781) 862-8680 (Work) now disabled‡
PERSONAL DATA	Citizenship: U.S.	Held Secret DOD Clearance: 1973-'01
Married with two adult sons	Birth date: 9 November 1945	His paternal grandfather continued to work as a pharmacist into his late 70's.
EDUCATION	Additional Language-Latin 4yrs.	
Degree/Major	**School**	**Graduation Date/G.P.A.**
Ph.D. in Electrical Engineering: Stochastic Control and Estimation	University of Iowa, Iowa City	February 1971 3.96/4.00
MSEE/Control Systems	University of Iowa, Iowa City	February 1969 3.91/4.00
BSEE (Magna cum Laude)/Electrical Engineering (electronics)	Howard University, Washington, DC	June 1967 3.65/4.00
EMPLOYMENT HISTORY		
Name of Employer	**Period of Employment**	**Duty**
Google contractor via Kelly Services	4/9/07– 4/8/09 (evenings)	Swing Shift Scanner & Quality Assurance Operator for 2-D images
TeK Associates, Lexington, MA	12/98-Present	CEO/ Principal Investigator/Consulting systems analyst in radar target tracking filter issues, INS & GPS navigation, and associated software specs.
Gemini Industries (which at that time held exclusive MITRE BOA) Bedford, MA (pursued by MITRE request)	6/97-8/98	MITRE contractor in National Missile Defense NMD/UEWR (as consultant)
TeK Associates, Lexington, MA	7/92-6/97	CEO/Owner/Software Developer/ Principal Investigator/Engineering Consultant/Web Master
Northeastern University Graduate School of Engineering (evenings only)	1/90-6/95	Instructor teaching Optimal Control and Kalman Filters
Lincoln Laboratory of MIT	10/86-7/92	Member of Technical Staff
Intermetrics, Inc. [renamed AverStar, acquired by Titan then by L3]	11/79-8/86	Systems Engineer/Senior Analyst
The Analytic Sciences Corporation (**TASC**) [acquired by Litton, now part of Northrup Grumman] Reading, MA	2/73-10/79	Member of the Technical Staff
General Electric Corporate R& D Center, Schenectady, NY	2/71-2/73	Control Engineer
University of Iowa, Iowa City	2/68-2/69	Research and Teaching Assistant
Howard University, Wash. D. C.	1/67-8/67	Research Assistant

TeK Associates URL:**http://www.google.com/profiles/KalmanFilterMaven** e-mail: thomas_h_kerr@msn.com
9 Meriam Street, Suite 7-R Web Site: www.TeKAssociates.biz
Lexington, MA 02420-5312 ‡Phone interruptions are major bug source.

While pursing his engineering degrees, he took additional courses in physics (i.e., classical mechanics, modern physics: quantum mechanics, methods of mathematical physics) and advanced mathematics graduate courses (i.e., advanced calculus, complex variables, operational mathematics, point set topology, modern abstract algebra, real and complex analysis I, II, and measure theory I, II) beyond what were required for engineers at that time. His grades in these additional courses qualified him and allowed him to join Sigma Pi Sigma and Pi Mu Epsilon. He also took *Statistical Design of Experiments for Scientists and Engineers*. He has continued to follow-up on this topic and has acquired software tools in this area like *S-Plus*, *Excel* add-on's, and *MatLab Statistical Toolbox*.

Technical Summary

Thomas H. Kerr III's experience for the past 38+ years has been as a mathematically oriented R&D Algorithm Engineer, Senior Analyst/Systems Engineer, and Software Developer, encompassing various Kalman filters and related mathematically challenging theoretical evolutionary developments almost exclusively for DoD applications.

- Expert in theory and practice of Kalman Filters and Extended Kalman Filters (EKF) and other related Statistical Estimation techniques for both INS/GPS Navigation and for Radar Target Tracking. Some experience in target tracking filters for sonobuoys too.
- Presented his analysis and simulation at Naval Academy in '81& in ION Journal of type and frequency of necessary alternative external navaid fix usage in enhancing submarine INS accuracy by compensating for its inherent drift-rate versus exposure to enemy surveillance incurred in doing so.
- Familiar with alternative algorithms & approaches (0-1,J-V-C, Multi-hypotheses Tests, Murty) to multi-target tracking.
- Statistical Analysis/Statistical Design of Experiments. Extensive background in writing Plans and Procedures.
- Trail-blazed development of a Kalman filter accouterment: Two Confidence Region Failure Detection, from first principles by developing a test statistic and subsequently specifying False Alarm and Correct Detection Probabilities that were traded-off in specifying CFAR time-varying decision threshold for comparison to it in making decisions (as a particular ROC operating point). Coded simulation of all aspects in PL/1, ran test cases, and analyzed operational data after its implementation.
- Was first to recognize the utility of combining earlier "failure detection methodologies" with the results of "decentralized estimation", thus reaping a satisfying theoretical foundation for "redundancy management" for navigation applications. Received M. Barry Carlton Award from IEEE Aerospace and Electronic Systems for his publication elucidating these aspects. These results also presented at Institute of Navigation (ION) Conference.
- Possesses detailed knowledge of operational principles of GPS, of Inertial Navigation Systems (INS), and of host platform and environmental constraints for theoretical analysis and modeling. Similar knowledge of Strategic Radar aspects too.
- Results of his trailblazing analysis and evaluation of multi-sensor data collection using INS/GPS equipped support platform in Airborne map-data collecting was published in Institute of Navigation (ION) Proceedings of GPS94. He published "A Critique of GPS" in '01.
- Has performed Pattern Recognition Analysis using its techniques for MWS, & its supporting processing.
- 17 years Windows-based Software Development (prior experience was on mainframes for 20 years).
- Surveyed and analyzed alternative Decentralized filtering approaches to identify those satisfying constraints possessed by NAV applications of interest and conveyed results in our written reports and associated open literature publications (PLANS Proceedings & NATO AGARDograph) to customers: NADC (for JTIDS), Wright-Patterson AFB for MUF-BARS/ICNIA for Advanced Tactical Fighter (ATF).
- Developed supporting theory for and implemented a Cramer-Rao Lower Bound methodology in MatLab and Simulink on PC for Strategic Reentry Vehicle Radar Target Tracking for National Missile Defense (NMD). These and other results were conveyed in his NMD Tracking Analysis Notebook (for XonTech & Raytheon in 1999). Wrote Radar Target Tracking Filter Software Specs for NMD for Raytheon (2000).

He still does long distance biking with the **Charles River Wheelman** (CRW) for fun since joining in 1977 and is in excellent health. He has also been a CRW ride leader (1990-1997). He is an ex-marathoner, with 12 prior marathons under his belt (in the 1970's) as a member of the Cambridge Sports Union. Both he and his wife studied **American Combat Karate** in the 1970's.

Work done by Thomas H. Kerr III (TeK Associates) on UEWR National Missile Defense

For the four years ('97-'01), participated in the development of the next generation of **U**pgraded **E**arly **W**arning **R**adar (**UEWR**) target tracking filters for National Missile Defense as a consultant, first, for The MITRE Corporation (via Gemini Industries '97-'98) [1]-[4], then directly for XonTech ('98-'99) [5], and, subsequently, directly for Raytheon ('99-'00) [6]-[9] for two contract periods. He has personally developed Cramer-Rao lower bound evaluation analysis and corresponding MatLab software for gauging nonlinear filter performance and has contributed on other tracking issues such as specifying and documenting (first, as preliminary PowerPoint presentations, then as Software Requirements Specifications) the Extended Kalman Filter and Batch filters to be used and in writing the tracking Notebook single-handedly and other final reports and memos. As part of associated modeling considerations, he also investigated use of the Lambert algorithm versus use of Levenberg-Marquardt least squares fitting and variations thereof in determining when to include the second zonal harmonic of gravity to account for the oblateness of the earth and when it can be ignored for UEWR. He is gaining more experience with the Interactive Multiple Model (IMM) estimation approach as well.

As a contractor (via Gemini BOA) at The MITRE Corporation in consulting on National Missile Defense target tracking filters, he has provided Cramer-Rao lower bound evaluation analysis and its associated software implementation for gauging nonlinear filter performance [1]-[4] and has contributed on other issues as well relating to evaluating algorithms provided by other participating National Missile Defense (NMD) contractors.

1. Kerr, T. H., *NMD White Paper on Designated Action Item*, MITRE, Bedford, MA, January 1998.
2. Kerr, T. H., "Cramer-Rao Lower Bound Implementation and Analysis for NMD Radar Target Tracking," TeK Associates Technical Report No. 97-101 (for MITRE), Lexington, MA, 26-30 Oct. 1997.

3. Kerr, T. H., "Cramer-Rao Lower Bound Implementation and Analysis: CRLB Target Tracking Evaluation Methodology for NMD Radars," MITRE Technical Report, Contract No. F19628-94-C-0001, Project No. 03984000-N0, Bedford, MA, February 1998.
4. Kerr, T. H., "Developing Cramer-Rao Lower Bounds to Gauge the Effectiveness of UEWR Target Tracking Filters," Proceedings of AIAA/BMDO Technology Readiness Conference and Exhibit, Colorado Springs, CO, 3-7 August 1998.
5. Kerr, T. H., UEWR *Design Notebook-Section 2.3: Track Analysis*, TeK Associates, Lexington, MA, (for XonTech, Hartwell Rd, Lexington, MA), XonTech Report No. D744-10300, 29 March, 1999.
6. Kerr, T. H., and Satz, H. S., "Evaluation of Batch Filter Behavior in comparison to EKF," TeK Associates, Lexington, MA, (for Raytheon, Sudbury, MA), 22 November 1999 (PowerPoint Presentation).
7. Kerr, T. H., "TeK Associates' view in comparing use of a recursive Extended Kalman Filter (EKF) versus use of Batch Least Squares (BLS) algorithm for UEWR," TeK Associates, Lexington, MA, (for Raytheon, Sudbury, MA), 12 September 2000.
8. Kerr, T. H., "Considerations in whether to use Marquardt Nonlinear Least Squares vs. Lambert Algorithm for NMD Cue Track Initiation (TI) calculations," TeK Associates, Lexington, MA, (for Raytheon, Sudbury, MA), 27 September 2000.
9. Satz, H. S., Kerr, T. H., "Comparison of Batch and Kalman Filtering for Radar Tracking," *Proceedings of 10th Annual AIAA/BMDO Conference*, Williamsburg, VA, 25 July 2001, Unclassified.

PROFESSIONAL EXPERIENCE (emphasizing software):

Over 35 years experience as an **R&D systems engineer** and **software developer** in a variety of defense-related systems, being called upon to first **conceive of novel mathematical algorithms and prototype solutions to problems** posed by Department of Defense Navy and Air Force customers for various **Kalman filter** (optimal and sub-optimal estimation) applications in **Inertial Navigation**, and for using other navaids such as Loran-C, NavSat, Global Positioning System (**GPS**), and in **radar target tracking** (after first **simulating its behavior to appropriately set parameters through rigorous trade-off simulations and subsequent analyses**). After conceiving of the solutions, he then **designed and implemented these ideas in software**, and ultimately tested them (using, first, standard unit tests, then integration tests, and, after any subsequent changes, invoking a sequence of regression tests specially tailored to confirm that no desired prior functionality had been clobbered by the latest changes). Prior to the 1990's, his prototype implementations were typically done in **FORTRAN 66/77** or in **IBM's PL/1** language and then later manually converted to **assembly language** (by others[†]) for real-time implementation; however, now his initial implementations are in the higher level languages: **MatLab™ 6.5** and/or its **Simulink™ 5.0** adjunct (then afterwards he converts these prototypes using a **MatLab-to-C** compiler for cross-platform transportability). An alternative that he still frequently uses is implementation of parts of the solution in **Absoft™ 6.3 or Digital Visual Fortran™ 90/95**. He usually uses **Microsoft Visual Basic™ 3.0-6.0 and Access '97/2K** for implementing the Graphical user Interfaces (**GUI**) since VB's "App.Activate" and "shell" commands can be used to run other new or legacy software executables and *.bat files (and even run old legacy **DOS** files without any DOS screen appearing as a tip off to the end user). He has both **Wise Installer** version 8.12 and **PC-Install** Version 7 but has more experience with the Wise Installer. As an experienced consultant, he has been called in to **debug programs written by others** and to **write Software Requirement Specifications** in his specialty area of Kalman Filtering. He also has experience writing **proposals** in response to Commerce Business Daily (**CBD**) and Small Business Innovation Research (**SBIR**) program solicitations. He is a **seasoned presenter** of findings, as personally prepared and conveyed via **PowerPoint™**. He has published 130+ peer–reviewed journal papers and company reports summarizing new and innovative results. He's a Senior Member of both IEEE and AIAA and is a 25+ year Institute of Navigation (ION) member (also for 8 years in Microsoft Software Developer's Network). He is a candidate to become an IEEE Fellow.

2004 To Present — **For TeK Associates: Further developed and refined software for TeK Associates primary product: TK-MIP™ as we convert from a pure service company to one offering a product.**

- Served as Web Master in creating content for our Web Site: **www.TeKAssociates.biz**
- Wrote four technical papers in the estimation and Kalman filtering area as further advertising of our technical expertise in this same area as our software product. Two have already been accepted for publication, the other two are still under review. Two have already appeared.
- Took course in National Instrument's **TestPoint™** in order to further develop **TK-MIP** by allowing it to receive sensor measurement data from a variety of PC ports and using a variety of different standard Input/Output protocols and hardware connections currently in vogue.
- Wrote TeK Associates' Business Plan for NECINA Business Plan Competition in 2007. Revised and submitted to Google Ventures in April 2009.

2003 (6 wks in the fall) — **For Arête Associates' Navy AROSS program,** under a subcontract, he developed a Kalman filter-based covariance analysis program **in MatLab™**.

- Used covariance analysis program, mentioned above, to perform a quantitative analysis of the relative pointing accuracy provided by each of several alternative candidate INS platforms of

[†] He has hands-on real-time **assembly language** experience from early assignment at General Electric R&D Center in the early '70's.

varying quality (and cost) by using high quality GPS [P(Y)-code, differential, or kinematic] fixes at a high rate to enhance the INS with frequent updates to compensate for degradations incurred with time due to specific inherent gyro drift rates characterizing each of several INS candidates being evaluated.

2001, 2002 (summers) **For Boeing Company:**

- Prepared a proposal (as specifically solicited by them) to improve the tracking filter used for NMD/GMD in the application below. Published two papers as an outgrowth of that work.

June 1999 To October 2000 **Wrote specialty "tracking" segments of Software Requirements Specifications for Updated Early Warning Radar (UEWR) with a direct TeK Associates sub-contract from Raytheon Sudbury, MA as RADAR SYSYEM CONSULTANT specializing in Tracking Issues.**

- Participated in the **development** (and **debug**), and **refinement** of parameters in the **implementation** and **test** of various candidate Extended Kalman Filters (EKF's) for UEWR, as implemented in **Fortran** on several different UNIX platforms and targeted for eventual C/C++ implementation. Proto-types were first in **MatLab™ 5.3** and **Fortran** on a PC for our experimental investigations.
- Wrote an **M/S Word** memo "On use of Lambert algorithm versus use of Levenberg-Marquardt algorithm for EKF Track Initiation (**TI**)".
- Participated in the writing (**M/S Word™**) of the classified and proprietary **Software Requirements Specification** (SRS) for Raytheon's Batch Least Squares (BLS) Algorithm, RVCC EKF, RUV EKF, Interactive Multiple Model (**IMM**) Filter, and Track Initiation (**TI)**.

December 1998 To May 1999 **Performed System Analysis Studies of UEWR As a subcontractor to: XonTech, Inc. (Lexington, MA) (the original LSI) and performed as RADAR SYSYEM CONSULTANT specializing in Tracking Issues.**

- Exercised the same **CRLB** evaluator for gauging tracking accuracy that had previously been developed below for MITRE, and applied it to XonTech's more extensive and more realistic **TD/SAT™** simulations and compared results to Extended Kalman Filter (EKF) behavior**.**
- Prepared and delivered **M/S PowerPoint™** presentation of the above results.
- Became familiar with parameter settings of XonTech's **TD/SAT** and associated corresponding UEWR radar performance.
- Single-handedly wrote the 150 page UEWR Analysis Design Notebook on Tracking, summarizing the tracking behavior established to date for UEWR in 1999.

May 1997 To August 1998 **Performed System Analysis Studies of UEWR As a contract engineer to: MITRE (Bedford, MA) via a contract from Gemini Industries (BOA), performing as RADAR SYSYEM CONSULTANT specializing in Tracking Issues.**

- Designed and developed a Cramer-Rao Lower Bound (**CRLB**) evaluator (an area of my prior expertise, published in 1974 and in 1989) for gauging estimator tracking accuracy and personally implemented this evaluation tool in **MatLab™ 4.2**.
- Documented the **CRLB** implementation and User instructions.
- Exercised this **CRLB** tool to **evaluate** expected performance of best possible tracking algorithms over a variety (40) of specified trajectories, as viewed by different Early Warning Radar locations and their respective characteristics.
- Wrote a TeK Associates' final report (in **LaTeX**) and then as a MITRE final report (in **M/S Word**) summarizing the results of these **CRBL** evaluations.
- Wrote a White Paper (in **M/S Word**) for MITRE considering both **CRLB** and other aspects that affect tracking accuracy for UEWR**.**
- Wrote (in **LaTeX™**) and delivered a published peer-reviewed paper on all the above aspects at *AIAA Ballistic Missile Defense Organization (BMDO) Conference and Workshop* at Colorado Springs in August 1998.

October, 1992 To Spring 1997 **Designed, Developed, Implemented, Tested, and Documented TK-MIP™**
Client: Myself, doing business as (dba) TeK Associates
CEO/Chief Programmer/acting Advertising & Marketing Manager

- Design of comercial **TK-MIP™** software for the PC as a way to quickly and cost-effectively implement various Kalman filter design options as a prototype so that user avoids the need to do any programming whatsoever (except in output transformations at the user's volition).

- Developed several closed-form test cases to Verify and Validate **TK-MIP**™ and that can be similarly used for any other software of this type.
- Implemented **TK-MIP** Graphical User Interface (**GUI**) in **Visual Basic (VB) 3.0**, with other critical portions implemented in **VB 5.0** and **6.0** (so that they are truly compiled identically to output of **M/S VC/C++** for speed).
- Performed **unit and integration testing** of **TK-MIP**™. Performed thorough **regression tests** after every major change.
- Prepared two levels of selectable **on-line user guide** for **TK-MIP**™ to prompt and support both the novice and experienced user.
- Did publicity and marketing: published successful applications in peer-reviewed professional IEEE, SPIE, AIAA, and Institute of Navigation journals (in GPS use for airborne image collection for mapping; for image enhancement and multi-sensor data fusion; for simplifying iterated EKF implementation). Had a total of 9 technical publications in 2001. Four in 2005. Used Microsoft Word and PCTech LaTeX to prepare these documents. Created his own artwork and graphics, as needed.

Relevant prior experience:

For Group 95 at Lincoln Laboratory:

- Performed investigation of various multi-channel generalizations of *maximum entropy* technique for spectral estimation and applied two alternative implementations to the estimation of Primary Polarization (PP) and Orthogonal Polarization (OP) components of Reentry Vehicle (RV) wake signatures from (Kwajalein Island) *Tradex* wideband radar data. Also explored use of *Matrix Spectral factorization* computer program in conjunction with use of *realization theory* results on this same problem. *Tradex* radar uses coherent phase processing so data and algorithm formulations had to accommodate both *real* and *imaginary* processing using *complex* variable processing considerations. He first validated software under development with synthetic data simulated as problems of known solution, then later applied validated s/w implementation to actual *Tradex* radar data (provided to us on magnetic tape). Same techniques were used in reverse to digitally emulate signatures of real targets for purposes of enemy deception as an electronic decoy mimicking an actual RV's wake.
- Served as an invited speaker in the videotaped in-house *Distributed Sensor Systems Workshop* and participated in the associated round-table panel discussion which followed.
- Looked into aspects of satellite survivability for Strategic Defense Initiative (SDI) including the interaction and/or impact of evolutionary navigation, pointing, and triangulation technology associated with Angles-Only Tracking (AOT) [a.k.a. bearings-only tracking, as with coordinated electro-optic sensors or with range-denied jammed radars].
- Performed study to assess the utility of using two range-denied (jammed) radar to track an incoming RV via triangulation. Varied sensor location from target, orientation of sensors, and baseline length as well as radar pulse repetition frequency (PRF) and Kalman filter initial conditions to assess their effect. He developed a new computer program for this application. Prior errors in the methodology were gently and diplomatically pointed out.
- Developed an Extended Kalman Filter (EKF) for RV target tracking using either radar or passive optics measurements (exclusively or in combination). Took steps to make software that was developed compatible with eventual inclusion within a multi-target tracking framework for updating/maintaining target track files and properly extinguishing or pruning nonexistent false target reports. Planned use of on-line time-varying filter-generated variance within adaptive tracking gates. This was all for a detailed simulation. Generated detailed intermediate software design memos (already listed above) and unit tests and performed integration testing as well. Looked into other state-of-the-art approaches to tracking maneuvering targets, of solving the resource "assignment problem" inherent in multi-target tracking, for implementing the solutions, and for handling the related problem of multi-sensor fusion using a similar methodology.

For Group 53 at Lincoln Laboratory:

- For airborne data collection and navigation, specified a procedure for pre-flight mission planning and data patch preparation/grooming via INS/GPS waypoint insertion and retro-reflector pre-placement to designate anticipated swath row boundaries of sensor footprint and recommended additional use of colored balloons (and other special end-of-row markers) to signal aircraft to initiate 3 minute 180^{o} turns for back-sweep coverage of adjacent rows for parsimonious but adequate row overlap in multi-sensor data recording.

Explanation: He applied Kalman filter/navigation theory background to primarily perform investigation to recommend particular navaid use (type and frequency of fixes) out of candidate VOR/DME, GPS, or surveyed retro-reflector locations (as viewed from the onboard imaging equipment in real-time) to support tight accuracy goals in using the airborne LASERNAV II Inertial Navigation System (INS) during data collection missions of the test aircraft over Electronic Terrain Board data patches so that swaths of the down-looking sensor have sufficient location accuracy to avoid blatant gaps in measurement coverage but, conversely, don't overlap too much (thus avoiding overly redundant data recording).

For Intermetrics, Inc., **Cambridge, MA**, the following navigation, Kalman filtering, or signal-processing related investigations were performed:

- Pioneered failure detection/redundancy management/decentralized filter formulations, as developed under Integrated Communications, Navigation, and Identification for Avionics (ICNIA) for the Advanced Tactical Fighter (ATF).
- As part of a Government Review Board, critiqued Kalman filter design and performance of early Magnavox version of Precise Integrated Navigation System (PINS), as is being developed for Minesweepers.
- Surveyed and summarized how Phase II Global Positioning System (GPS) works and options/variations in cross-checking both contractor's compliance (and in tagging violations) during the Phase II demonstration and competition between Magnavox and Rockwell International for follow-on Phase III.
- Worked on integration of Joint Tactical Information and Distribution System (JTIDS) Relative Navigation (RelNav) into aircraft/aircraft carriers and JTIDS/GPS integration issues.
- Performed test and evaluation of data monitoring GPS Phase II integration on Strategic Submersible Nuclear attack submarine SSN-701 *La Jolla* and the susceptibility to detection by enemy surveillance in its use of GPS via the AN/BRA-34 antenna.
- Found stable decentralized Kalman filter formulations for JTIDS RelNav.
- Participated in writing several technical proposals.

For The Analytic Sciences Corporation (TASC) in Reading, MA, the following navigation, Kalman filtering, and fault detection/signal-processing related investigations/tasks were performed:

- Posed the problem of optimal navigation fix utilization for submarines in such a way that navigation accuracy is adequate while exposure to enemy surveillance is minimized. Considerations also included associated sweep-rate exposure to enemy surveillance and thwarting enemy ASW search procedures.
- Developed a failure detection technique for monitoring performance of the Electrostatically Supported Gyro Monitor (ESGM) on Trident submarines. Used confidence regions, as previously developed in his Ph.D. thesis and refined them for this application. Was actively involved in the development, analysis, simulation, and programming using both covariance analysis and Monte-Carlo simulation. Involvement included real data validation of the proposed algorithm after handing it over to Sperry Systems Management (SSM now UNISYS, Great Neck, NY) to implement.
- Participated in writing one technical proposal.

For General Electric Corporate Research & Development Center (in Schenectady, NY), was involved in various aspects of the following two major projects:

- Making improvements to Automated Dynamic Analyzer (ADA) and performing simulations in ADA.
- Simulated the emissions of a steam car using Automated Dynamic Analyzer.
- Developing and implementing an algorithm for real-time mini-computer processing (GE-PAC.30) of data in the ultrasonic location of flaws in the rotors of large turbines.

Professional References:

Dr. George Galdos, Computational Solutions, Inc.,
118 Rustic Lane, Reading, MA 01867;
Tel: (781) 942-0416 (Home); (781) 942-0896 (W);
At **CAST** during the day: (978) 667-8720 (work)

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Bettendorf, Iowa 52722
Tel.: (563) 332-9191

Professional Affiliations: Institute of Electrical and Electronics Engineers (IEEE) Senior Member (Automatic Control, Aerospace and Electronic Systems, Information Theory, Signal Processing), American Institute of Aeronautics and Astronautics (AIAA) Guidance, Control and Dynamics (Senior Member), Institute of Navigation (ION), life member of American Defense Preparedness Association (ADPA) now renamed ADIA, American Defense Industrial Association, American Association for the Advancement of Science (off and on), Mathematical Association of America (off and on), American Statistical Association (off and on), Association for Computing Machinery (off and on), Visual Basic User's Group, Microsoft Developer's Network (Level 2, off and on), Instrumentation, Systems, and Automation Society (ISA), New England Chinese Information & Networking Association (NECINA).

Honors: Junior High Rensselaer (RPI) Medal in 1960 for Mathematics and Science proficiency, High School Honor Society in 1962, High School Mathematics and Science Award in 1963, Music Educator's Award 1963; Tau Beta Pi, Pi Mu Epsilon (student president of the chapter at Howard in '66-'67), Eta Kappa Nu, Sigma Pi Sigma. Western Electric Award (1966), Douglas Aircraft Award (1967), Who's Who in American Schools and Colleges (1967), $340 Student Prize Paper Contest Sponsored by the Federal Power Commission (1967), National Science Foundation Traineeship (1968-1970), Acting chairman of Stochastic Control Session of IEEE Conf. on Decision & Control (1975), won 1988 M. Barry Carlton Award and $2000 honorarium for Outstanding Paper [56] to appear in IEEE Aerospace and Electronic Systems Transactions in 1987 [for more details, please see page 822 of Vol. 24, No. 6, Nov. 1988 of the aforementioned journal], joined Sigma Xi (in 1990), delivered Distinguished Engineer Lecture at University of Maryland (UMBC in Feb. 1990). Listed in Who's Who in the East ('92), in Technology ('93), in the World ('98), in the USA ('03), in Finance and Business ('05), in America ('06), and in Science and Engineering ('06). Was listed in Global Register's Who's Who of Executives and Professionals in '05. Chairman of local Boston section of IEEE Control Systems '90-'92, '01-'04; Chairman of the local IEEE

Control Systems Steering Committee '92-'94, vice-Chairman of the local IEEE Control Systems section '95-'96, at-large member of the local IEEE Control Systems Steering Committee '97-'99. Co-chairman of Sensors, Components, and Algorithms for Navigation session at the Institute of Navigation (ION) Annual Summer Conference (1999) in Cambridge, MA. Over 130+ publications in the open literature and as company reports. His publications are frequently cited by other independent authors and researchers (e.g., see 120+ citations on URL: www.tekassociates.biz).

Other Relevant Representative Publications

He has published the following three book chapters:

1. Kerr, T.H., and Chin, L., "The Theory and Techniques of Discrete-Time Decentralized Filters," in *Advances in the Techniques and Technology in the Application of Nonlinear Filters and Kalman Filters*, edited by C.T. Leondes, AGARDograph No. 256, Noordhoff International Publishing, Lieden, 1981.
2. Kerr, T. H., "Computational Techniques for the Matrix Pseudoinverse in Minimum Variance Reduced-Order Filtering and Control," in *Control and Dynamic Systems-Advances in Theory and Applications*, Vol. XXVIII: Advances in Algorithms and computational Techniques for Dynamic Control Systems, Part 1 of 3, C. T. Leondes (Ed.), Academic Press, NY, 1988;
3. Kerr, T. H., "Numerical Approximations and Other Structural Issues in Practical Implementations of Kalman Filtering," a chapter in *Approximate Kalman Filtering*, edited by Guanrong Chen, World Scientific, NY, 1993;

where all three of the above pertain to aspects of Kalman filtering.

He has several publications relating to underlying numerical computational details, as arise in implementing Kalman filters:

4. Kerr, T. H., "An Invalid Norm Appearing in Control and Estimation," *IEEE AC Transactions*, Vol. 23, No. 1, Feb. 1978.
5. Kerr, T. H., "Testing Matrices for Definiteness and Application Examples that Spawn the Need," *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 10, No. 5, pp. 503-506, Sept.-Oct., 1987.
6. Kerr, T. H., "Rationale for Monte-Carlo Simulator Design to Support Multichannel Spectral Estimation and/or Kalman Filter Performance Testing and Software Validation/Verification Using Closed-Form Test Cases," MIT Lincoln Laboratory Report No. PA-512, Lexington, MA, 22 December 1989 (BSD).
7. Kerr, T. H., "Multichannel Shaping Filter Formulations for Vector Random Process Modeling Using Matrix Spectral Factorization," MIT Lincoln Laboratory Report No. PA-500, Lexington, MA, 27 March 1989.
8. Kerr, T. H., "Status of CR-Like Lower bounds for Nonlinear Filtering," *IEEE AES Transactions*, Vol. 25, No. 5, pp. 590-601, Sep. 1989.
9. Kerr, T. H., "On Misstatements of the Test for Positive Semidefinite Matrices," *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 13, No. 3, pp. 571-572, May-Jun. 1990.
10. Kerr, T. H., "Fallacies in Computational Testing of Matrix Positive Definiteness/Semidefiniteness," *IEEE AES Transactions*, Vol. 26, No. 2, pp. 415-421, Mar. 1990.
11. Kerr, T. H., "A Constructive Use of Idempotent Matrices to Validate Linear Systems Analysis Software," *IEEE AES Transactions*, Vol. 26, No. 6, pp. 935-952, Nov. 1990.
12. Kerr, T. H., "Emulating Random Process Target Statistics (Using MSF)," *IEEE AES Trans*, Vol. 30, No. 2, pp. 556-577, Apr. 1994.
13. Kerr, T. H., "Exact Methodology for Testing Linear System Software Using Idempotent Matrices and Other Closed-Form Analytic Results," *Proceedings of SPIE*, Session 4473: Tracking Small Targets, pp. 142-168, San Diego, 29 July-3 Aug. 2001.

and as encountered in several diverse applications:

14. Kerr, T. H., "Angle-Only Tracking," slide presentation for Reentry Systems Program Review, Lincoln Laboratory, Lexington, MA, 10 Jan. 1989.
15. Kerr, T. H., "Streamlining Measurement Iteration for EKF Target Tracking," *IEEE Transactions on AES*, Vol. 27, No. 2, Mar.1991.
16. Kerr, T. H., "Use of GPS/INS in the Design of Airborne Multisensor Data Collection Missions (for Tuning NN-based ATR algorithms)," the Institute of Navigation *Proceedings of GPS-94*, Salt Lake City, pp. 1173-1188, 20-23 Sep. 1994.
17. Kerr, T. H., "Assessing and Improving the Status of Existing Angle-Only Tracking (AOT) Results," *Proceedings of the International Conference on Signal Processing Applications & Technology*, Boston, pp. 1574-1587, 24-26 Oct. 1995.
18. Kerr, T. H., "Extending Decentralized Kalman Filtering (KF) to 2-D for Real-Time Multisensor Image Fusion and/or Restoration,," *Proceedings of SPIE Conference*, Vol. 2755, Orlando, pp. 548-564, 8-10 Apr. 1996.
19. Kerr, T. H., "Extending Decentralized Kalman Filtering (KF) to 2D for Real-Time Multisensor Image Fusion and/or Restoration: Optimality of Some Decentralized KF Architectures," *Proceedings of the International Conference on Signal Processing Applications & Technology*, Boston, MA, 7-10 Oct. 1996.
20. Kerr, T. H., "Developing Cramer-Rao Lower Bounds to Gauge the Effectiveness of UEWR Target Tracking Filters," *Proceedings of AIAA/BMDO Technology Readiness Conference and Exhibit*, Colorado Springs, 3-7 August 1998.
21. Kerr, T. H., UEWR Design Notebook-Section 2.3: Track Analysis, TeK Associates: XonTech Report No. D744-10300, 29 March 1999.
22. Kerr, T. H., "Considerations in whether to use Marquardt Nonlinear Least Squares vs. Lambert Algorithm for NMD Cue Track Initiation (TI) calculations," TeK Associates Technical Report No. 2000-101, Lexington, MA, (for Raytheon, Sudbury, MA), 27 September 2000.
23. Satz, H. S., Kerr, T. H., "Comparison of Batch and Kalman Filtering for Radar Tracking," *Proceedings of 10th Annual AIAA/BMDO Conference*, Williamsburg, VA, 25 July 2001.

24. Kerr, T. H., "New Lamps for Old: a shell game for generalized likelihood use in radar? Or this isn't your father's GLR!," *Proceedings of SPIE*, Session 4473: Tracking Small Targets, pp. 476-483, San Diego, CA, 29 July-3 Aug. 2001.

He has sufficient breadth to analyze other issues besides just those relating to Kalman Filtering such as GPS integration, Sonobuoy passive target tracking, Surveillance sweeprates, and Neural Networks:

25. Kerr, T. H., "Impact of Navigation Accuracy in Optimized Straight-Line Surveillance/Detection of Undersea Buried Pipe Valves," *Proceedings of National Marine Meeting of the Institute of Navigation*, Cambridge, MA, 27-29 Oct. 1982.
26. Kerr, T. H., "Phase III GPS Integration; Volume 1: GPS U.E. Characteristics," Intermetrics Report IR-MA-177, Cambridge, MA, Jan. 1983.
27. Kerr, T.H., "GPS/SSN Antenna Detectability," Intermetrics Report No. IR-MA-199, Cambridge, MA, 15 Mar. 1983
28. Kerr, T. H., "Assessment of the Status of the Current Post-Coherent Localization Algorithm," Intermetrics Report No. IR-MA-319, 31 May 1984.
29. Kerr, T. H., "An Analytic Example of a Schweppe Likelihood Ratio Detector," *IEEE AES Transactions*, Vol. 25, No. 4, pp. 545-558, Jul. 1989.
30. Kerr, T. H., "Critique of Some Neural Network Architectures and Claims for Control and Estimation," *IEEE AES Transaction*, Vol. 34, No. 2, pp. 406-419, Apr. 1998.
31. Kerr, T. H., "Further Critical Perspectives on Certain Aspects of GPS Development and Use," *Proceedings of 57th Annual Meeting of the Institute of Navigation*, pp. 592-608, Albuquerque, NM, 9-13 Jun. 2001.
32. Kerr, T. H., "Vulnerability of Recent GPS Adaptive Antenna Processing (and all STAP/SLC) to Statistically Non-Stationary Jammer Threats," *Proceedings of SPIE,* Session 4473: Tracking Small Targets, pp. 62-73, San Diego, CA, 29 July-3 Aug. 2001.
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34. Kerr, T. H., "Comment on 'Precision Free-Inertial Navigation with Gravity Compensation by an Onboard Gradiometer'," *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 30, No. 4, July-Aug. 2007.

His historical publications constituting a significant development in submarine navigation trade-off considerations between frequency of external navaid usage (to maintain sufficient navigation accuracy for possible launch) versus exposure to enemy surveillance:

35. Kerr, T. H., "Preliminary Quantitative Evaluation of Accuracy/Observables Trade-off in Selecting Loran/NAVSAT Fix Strategies," TASC Technical Information Memorandum TIM-889-3-1, Reading, MA, December 1977 (Confidential).
36. Kerr, T. H., "Improving C-3 SSBN Navaid Utilization," TASC TIM-1390-3-1, Reading, MA, August 1979 (Secret).
37. Kerr, T. H., "Modeling and Evaluating an Empirical INS Difference Monitoring Procedure Used to Sequence SSBN Navaid Fixes," *Proceedings of the Annual Meeting of the Institute of Navigation*, U.S. Naval Academy, Annapolis, Md., 9-11 June 1981 (reprinted in *Navigation: Journal of the Institute of Navigation*, Vol. 28, No. 4, pp. 263-285, Winter 1981-82).
38. Kerr, T. H., "Sensor Scheduling in Kalman Filters: Evaluating a Procedure for Varying Submarine Navaids," *Proceedings of 57th Annual Meeting of the Institute of Navigation*, pp. 310-324, Albuquerque, NM, 9-13 June 2001.

Historical publications where he personally developed the Two Confidence Region Failure Detection approach:

39. Kerr, T. H., "Poseidon Improvement Studies: Real-Time Failure Detection in the SINS/ESGM," TASC Report TR-418-20, Reading, MA, June 1974 (Confidential).
40. Kerr, T. H., "Failure Detection in the SINS/ESGM System," TASC Report TR-528-3-1, Reading, MA, July 1975 (Confidential).
41. Kerr, T. H., "Improving ESGM Failure Detection in the SINS/ESGM System (U)," TASC Report TR-678-3-1, Reading, MA, October 1976 (Confidential).
42. Kerr, T. H., "Failure Detection Aids for Human Operator Decisions in a Precision Inertial Navigation System Complex," *Proceedings of Symposium on Applications of Decision Theory to Problems of Diagnosis and Repair*, Keith Womer (editor), Wright-Patterson AFB, OH: AFIT TR 76-15, AFIT/EN, Oct. 1976, sponsored by Dayton Chapter of the American Statistical Association, Fairborn, Ohio, June 1976.
43. Kerr, T. H., "Real-Time Failure Detection: A Static Nonlinear Optimization Problem that Yields a Two Ellipsoid Overlap Test," *Journal of Optimization Theory and Applications*, Vol. 22, No. 4, August 1977.
44. Kerr, T. H., "Statistical Analysis of a Two Ellipsoid Overlap Test for Real-Time Failure Detection," *IEEE Transactions on AC*, Vol. 25, No. 4, August 1980.
45. Kerr, T. H., "False Alarm and Correct Detection Probabilities Over a Time Interval for Restricted Classes of Failure Detection Algorithms," *IEEE Transactions on IT*, Vol. 28, No. 4, pp. 619-631, July 1982.
46. Kerr, T. H., "Examining the Controversy Over the Acceptability of SPRT and GLR Techniques and Other Loose Ends in Failure Detection," *Proceedings of the American Control Conference*, San Francisco, CA, 22-24 June 1983.
47. Kerr, T. H., "Comments on 'A Chi-Square Test for Fault Detection in Kalman Filters'," *IEEE Transactions on AC*, Vol. 35, No. 11, pp. 1277-1278, November 1990.
48. Kerr, T. H., "A Critique of Several Failure Detection Approaches for Navigation Systems," *IEEE Transactions on AC*, Vol. 34, No. 7, pp. 791-792, July 1989.
49. Kerr, T. H., "On Duality Between Failure Detection and Radar/Optical Maneuver Detection," *IEEE Transactions on AES*, Vol. 25, No. 4, pp. 581-583, July 1989.
50. Kerr, T. H., "Comments on 'An Algorithm for Real-Time Failure Detection in Kalman Filters'," *IEEE Trans. on AC*, Vol. 43, No. 5, pp. 682-683, May 1998.

51. Kerr, T. H., "Integral Evaluation Enabling Performance Trade-offs for Two Confidence Region-Based Failure Detection," *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 29, No. 3, pp. 757-762, May-Jun. 2006.

His publications addressing Decentralized Kalman Filtering:

52. Kerr, T. H., "Stability Conditions for the RelNav Community as a Decentralized Estimator-Final Report," Intermetrics, Inc. Report No. IR-480, Cambridge, MA, 10 August 1980
53. Kerr, T. H., and Chin, L., "A Stable Decentralized Filtering Implementation for JTIDS RelNav," Proceedings of *IEEE* Position, Location, and Navigation Symposium, Atlantic City, NJ, 8-11 December 1980.
54. Carlson, N. A., Kerr, T. H., Sacks, J. E., "Integrated Navigation Concept Study," Intermetrics Report No. IR-MA-321, 15 June 1984.

His publications that combine the ideas of failure detection with those of decentralized Kalman Filtering to yield a breakthrough rigorous basis for system reconfiguration and redundancy management:

55. Kerr, T. H., "Decentralized Filtering and Redundancy Management Failure Detection for Multi-Sensor Integrated Navigation Systems," *Proceedings of the National Technical Meeting of the Institute of Navigation* (ION), San Diego, CA, 15-17 January 1985.
56. Kerr, T. H., "Decentralized Filtering and Redundancy Management for Multisensor Navigation," *IEEE Trans. on AES*, Vol.23, No. 1, pp. 83-119, Jan. 1987. **[This won 1988 M. Barry Carlton Award for Outstanding 1987AES Paper.]**

Tom's publications have recently been cited more than 120 times by other independent Researchers, as may be verified by viewing a representative listing at http://www.tekassociates.biz/index.html#Citations.

Continuing Education (Non-Degree Courses):

- Advanced Calculus, Summer, George Washington University, 1967;
- Complex Variables, Summer, George Washington University, 1967;
- Kalman Filtering, Summer, UCLA, 1969;
- Public Speaking, G.E. Marketing Program, 1972;
- Kalman Filtering and LQG Control, MIT Summer, 1974;
- Microprocessor Workshop, IEEE CDC Course, 1977;
- TASC Navigation Technology Internal Course 1976-1977;
- Global Positioning System (GPS), Intermetrics Internal Course, 1979;
- Strapdown Inertial Nav. Workshop, PLANS, taught by Paul Savage, 1982;
- Ada, IEEE Course, 1982;
- Radar Technology, IEEE Course, 1982;
- C3I, IEEE Course, 1983;
- Ada, Intermetrics Internal Course (Intermetrics with AF Ada won the development competition vs. Softech's Army Ada), 1983;
- Digital Signal Processing, IEEE Course, 1984;
- Advanced Techniques of Spectral Estimation, IEEE Course, 1984;
- VHSIC Applications Workshop, Palisades Institute, 1984;
- Geometric Arithmetic Array Processor Workshop, NCR Seminar, 1984;
- Expert Systems/AI, IEEE Course, 1985;
- Integrated Aircraft Navigation Systems, Navigation Technology (Navtech) Seminars, taught by James Farrell, 1985;
- Stratus Computer Course, Stratus Seminars, 1985;
- Radar, Past, Present and Future, IEEE Course, taught by Eli Brookner, 1986;
- SDI Tutorial at Electro' 86, IEEE Course, 1986;
- Fiber Optics Communication, IEEE Course, 1986;
- MMIC Technology, IEEE Course, 1987;
- Effective Communications, MIT Lincoln Laboratory Course, 1989;
- Management Without Authority, MIT Lincoln Laboratory Course, 1989;
- Advanced Integration of GPS and Inertial Navigation Systems, Navtech Seminars, taught by Neal Carlson &n Jeff Guier, 1989;
- Dealing with Conflict and with Difficult People, MIT Lincoln Laboratory Course, 1989;
- Multi-sensor Data Fusion and Multi-sensor Techniques (MSDF/MUST), University of Maryland, University College Center for Professional Development, taught by Prof. Cornelius T. Leondes, 1989;
- Presentation Techniques, MIT Lincoln Laboratory Course, 1990;
- "Spend a Day with an MIT Professor"-Prof. Michael Athans, MIT, May 1990;
- Passive and Active Infrared Sensors, IEEE Course, April/May 1991;
- Recursive Algorithms for Tracking in Clutter, AACC Tutorial Workshop, June 1991;
- Neural Networks in Control Systems, AACC Tutorial Workshop, June 1991;
- Lincoln Laboratory Radar Systems Course, 1991-1992;
- Beginner's and Intermediate WordPerfect, A.B.L.E., 1992;
- Beginner's Lotus 1-2-3, A.B.L.E., 1992;
- Overview of Proper Business Practices, 1992;

- Digital Adaptive Beamforming, Tutorial at IEEE National Radar Conference, 1993;
- Access Database Development (Introductory and Advanced), Softbite International, 1993;
- Introduction to the C Computer Language, IEEE Course, 1993;
- Introduction to C++ and Objects, Joint IEEE and Lowell Institute Course, 1993;
- Introduction to Visual Basic 3, Boston University, 1993;
- Introduction to SIMULINK, The MATH Works Course, 1993;
- Numerous VB lectures at VBITS Conference, 1993;
- Numerous software lectures at National Software Developers Conference, 1993;
- Intro to Visual Basic 3, New Technology Solutions, 1994;.
- Advanced Visual Basic 3, New Technology Solutions, 1994;
- Advanced Visual Basic 3, Microsoft, 1994;
- Numerous software lectures at Microsoft Software Developers Conference, 1994;
- Neural Networks and Adaptive Control, MIT Summer Course, 1994;
- Five different GPS courses: DGPS, GPS Attitude Determination, GPS/INS integration, GPS RAIM, NavTech Seminars, 1994;
- Wavelets, IEEE, 1995;
- Wavelets, ,Wellesley College (under Prof. Gil Strang of MIT), summer 1995;
- Neural Networks, IEEE, 1995;
- GPS, IEEE, 1995;
- Intro to Act 2.0, CompUSA, 1995;
- Act 2.0 Intermediate, CompUSA, 1995;
- Advanced Visual Basic 4, New Technology Solutions, 1995;
- Microsoft DOS (Intro, Intermediate, Advanced), CompUSA, 1995;
- Microsoft Windows (Intro, Intermediate, Advanced), CompUSA, 1995;
- Microsoft Word (Intro, Intermediate, Advanced), CompUSA, 1995;
- Microsoft Excel (Intro, Intermediate, Advanced), CompUSA, 1995;
- Microsoft PowerPoint (Intro, Intermediate), CompUSA, 1995;
- Microsoft Access (Intro, Intermediate, Advanced), CompUSA, 1995;
- Microsoft Project, CompUSA, 1995;
- Numerous VB and VC++ lectures at VBITS Conference, 1995
- Mapptitude GIS, Caliper Course at CompUSA, 1995;
- Quicken (Intro, Intermediate), CompUSA, 1995;
- QuickBooks (Intro, Intermediate), CompUSA, 1995;
- Corel Draw (Intro, Intermediate), CompUSA, 1995;
- Robust Control, MIT Summer Course, 1995;
- Windows 95, CompUSA, 1995;
- Windows NT, CompUSA, 1995;
- Using MarketPlace software, MarketPlace Course, 1995;
- Tactical and Strategic Missile Guidance, AIAA Course, taught by Dr. Paul Zarchan, 1995;
- Precision Stabilization and Laser Pointing Systems, SPIE Course, 1996;
- Introduction to Image Processing, SPIE Course, 1996;
- Multiple Sensor, Multiple Target Tracking, SPIE Course, taught by Dr. Oliver Drummond, 1996;
- Data Acquisition and Signal Conditioning, Data Translation, 1996;
- JAVA Jolt Seminar, Symantec, 1996;
- Advanced Digital Signal Processing-Modern Techniques, IEEE Course, 1996;
- Adaptive Array Processing for Airborne Radar-IEEE tutorial at International Symposium on Phased Array Systems and Technology, taught by Eli Brookner, 1996;
- Numerous software lectures at Microsoft Software Developers Conferences 1990-present;
- VBITS, and vendor product release presentations 1992-1998;
- Advanced M/S Excel, New Technology, April 1998;
- Satellite Communications, IEEE Course, 1998;
- Computational Optimal Control, AIAA Course, 1998;
- Adaptive Arrays, Sidelobe Canceller, CFAR, and Clutter Modeling, taught by Eli Brookner, IEEE Course, 2000-2001;
- Advanced M/S FrontPage, MicroCenter Course, 2001;
- Principles of Fourier Optics and Diffraction, SPIE Course, 2001;
- Boosting Your Professional Profile: Tools and Techniques for Advancing Your Career, SPIE Course, 2001;
- Wise Installer 8.1, a two day course from Wise in New York, NY, on 9/4/2001.
- Using ATEasy®, a two-day course taught by National Instruments/Keithly, 2005.