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)
PERSONAL DATA	Citizenship: U.S.	Held Secret DOD Clearance: 1973-'01 Held Wintel Clearance: 1986-'01 Secret Clearance Reactivated by GCR via eqip in Oct. 2019 for Draper Lab.
Married with two adult sons	Birth date: 9 November 1945	His paternal grandfather continued to work as a pharmacist well into his 70's.
EDUCATION		
<u>*Degree/Major*</u> Ph.D. in Electrical Engineering: Stochastic Control and Estimation	<u>*School*</u> University of Iowa/Iowa City	<u>*Graduation Date/G.P.A*</u>. 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		
<u>*Name of Employer*</u> Draper Laboratory (staffed by GCR Intl.)	<u>*Period of Employment*</u> 06/19 to 11/19	<u>*Duty*</u> Senior GNC Analyst on Trident D-II
Goodrich ISR (as staffed by Adecco USA, Inc.)	10/10/11-5/04/12 (8+ month Contract)	System Engineer investigating image geo-registration & Kalman filter issues
Google Books via Kelly Services (2nd shift)	4/9/07-4/8/09 (2 yr. contract)	Quality Assurance Operator for images
TeK Associates, Lexington, MA	12/98-Present	Consulting systems analyst in Radar Target Tracking filter and navigation issues (and associated software specs.)
Gemini Industries (MITRE BOA) Bedford, MA (as required by MITRE)	6/97-8/98	MITRE contractor/consultant in National Missile Defense UEWR
TeK Associates, Lexington, MA	7/92-6/97	Principal Investigator/Consultant/ Chief Programmer/CEO/Owner
Northeastern University Graduate School of Engineering, Electrical & Computer Engineering (ECE)	1/90-6/95	Instructor teaching Optimal Control & LQG with Kalman Filter (evenings only)
Lincoln Laboratory of MIT	10/86-7/92	Member of Technical Staff
Intermetrics, Inc. [name change: AverStar] (absorbed by Titan then by L3)	11/79-8/86	Systems Engineer/Senior Analyst
The Analytic Sciences Corporation (TASC) [became part of Northrop Grumman] Reading, MA	2/73-10/79	Member of the Technical Staff
General Electric Corporate Research and Development 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 e-mail: thomas_h_kerr@msn.com https://www.researchgate.net/profile/Thomas_Kerr_Iii
21 Cummings Park, Suite 230 https://academic.microsoft.com/#/detail/2424976702
Woburn, MA 01801-6396 https://scicomp.stackexchange.com/users/27180/thomas-h-kerr-iii
https://blogs.mathworks.com/headlines/2016/09/08/this-56-year-old-algorithm-is-key-to-space-travel-gps-vr-and-more/ (please see my 25 entries at the bottom) https://www.linkedin.com/in/thomaskerriiikalmanfiltermaven
https://scholar.google.com/citations?user=UjaYY4EAAAAJ&hl=en http://spie.org/profile/Thomas.Kerr+III-2982

Dr. Thomas H. Kerr III's experience for the past 40+ years, as a mathematically-oriented R&D algorithm engineer, systems engineer, and software developer, has encompassed various Kalman filter theoretical evolutionary developments for DoD applications in submarine and aircraft Inertial Navigation Systems (INS), in GPS, in Lamps Difar Sonar/Sonobouy target tracking, in JTIDS RelNav, and in radar target tracking for strategic reentry vehicles. He has an awareness of current target observables, countermeasures, counter-countermeasures, sweeprate exposure to enemy surveillance, pattern recognition classification procedures, neural network limitations, and support software issues for implementing promising algorithms-with particular emphasis on novel *state variable* model-based Kalman filter (**KF**) applications. He is cognizant and experienced in the following areas:

- Analysis/Simulation and software implementation of INS/GPS or INS/DGPS Navigation algorithms;
- Sensor or Actuator Failure Detection in Navigation Systems similar to GPS RAIM (Receiver Autonomous Integrity Monitoring);
- Algorithm Specification/Design/Implementation/IV&V/Software Documentation;
- Design, Evaluation, and Implementation of Decentralized or Distributed Kalman filters;
- Using Partial Differential Equations (PDE-based) Kalman filter constructs for thermal conduction, convection, and radiation for thermal diffusion (expertise in PDE's also extends to understanding methodology in proper use of Kolmogorov or Fokker-Planck Equations arising in nonlinear filtering [and in Electromagnetic theory for the hyperbolic wave equation of transmission lines and/or for antennas]);
- Use of 2-D Kalman filters for image processing resolution enhancements (with these Kalman filter constructs, along with Decentralized Kalman filters & image registration for multi-sensor fusion);
- Various novel approximate approaches for handling nonlinear filtering by being alert to possible improvements to supplant, replace, or augment Kalman filters such as:
  -Particle Filtering (**PF**) or Sigma-Point Filtering (only if they live up to their hype [which has not happened yet]) with careful assessment of their associated respective computational burdens;
  -with hopes for benefits in parallelization (multi-threaded parallel processing and/or embedded apps);
- Design, Evaluation, and Implementation of Angle-only tracking (AOT) or Bearings-0nly filtering (for passive sonar or range-denied jammed radar tracking)-both being highly nonlinear;
- Kalman filter tracking accoutrements like the handling of multiple target tracks (e.g., via use of Hungarian algorithm, Munkres algorithm, J-V-C algorithm, Murty's algorithm, Multiple Hypotheses Testing, or distributed Auction algorithm, and other approaches to solving the Assignment Problem of Operations Research), Matrix Spectral Factorization (MSF), and Cramer-Rao Lower Bound (CRLB) analysis and evaluation;
- Event detection (e.g., via use of Generalized Likelihood Ratio [GLR]), which utilizes the outputs associated with Kalman filters or statistical estimation, to identify faulty navigation components (i.e., INS gyro and accelerometer components, GPS receivers, Receiver Autonomous Integrity Monitoring [RAIM]) or for detecting target maneuvers via radar, IR, or sonar;
- Self-assembling or *self-organizing* networked sensors (perhaps exploiting different sections of the electromagnetic spectrum for multi-spectral or hyper-spectral assessments or determinations);
- Tactics for improving target observables such as certain sensor-host platform maneuvers to improve passive sonar observability, aircraft maneuvers to eliminate ambiguity associated with several different candidate INS component sources of owncraft INS failure or to reveal the presence of such failures during early stages of a mission before they have a more deleterious impact;
- Supporting new Monte-Carlo techniques (re-sampling) and associated supporting pseudo-random number and quasi-random number generation techniques germane to **PF** (also relevant to encryption);
- Investigations into *probability one* convergence arguments for assessing estimator convergence to true targets instead of relying on mere mean-square-convergence arguments inappropriately extrapolated from multitudinous Monte-Carlo trials (especially since successful National Missile Defense [**NMD**] interception is a single sample event rather than proximity to the target on average);
- Multi-channel generalizations to scalar *Maximum Entropy* spectral estimation (also model-based);
- Applying Electrical Network Synthesis using exclusively passive circuit elements (a'la Van Valkenberg: Brune, Reza, Bott-Duffin techniques).

He has novel ideas about using sensor-affiliated or dedicated decentralized Kalman filters to obtain different complementary perspectives of the same targets by simultaneously viewing the tactical or strategic situation from different aspect angles from GPS-derived known locations of the sensors; with measurement data also synchronized and time-tagged with GPS time (that can subsequently be easily related to Universal Coordinated Time, if need be).

Thomas Kerr III founded **TeK Associates** in 1992. While in school, he took additional courses in physics (classical mechanics and modern quantum physics) and extra advanced mathematics graduate courses (point set topology, modern algebra, real and complex analysis I & II, and measure theory) beyond what were required for engineers at the time. This has served him well in R&D endeavors for more than 4 decades. He has worked in the estimation area for over 38 years on DoD applications: (Poseidon/Trident) **submarines** navigation failure detection [5], [6], [9]-[11], [17], [132] and also posed and solved the problem of **SSBN** external navaid fix utilization while evading enemy surveillance as a "cat-and-mouse" game of "sensor schedule optimization" within a Kalman Nav filter context [13], [16], [21], [106], [123], [126] and Air Force **aircraft Navigation** [18], [19], [23]-[25], [28] (**failure detection and reconfiguration** in Navigation systems within owncraft position and attitude determination) [30], [35], [42]. In performing design and analysis for the aforementioned applications, he routinely implements requisite Monte-Carlo simulations for trade-off studies to set parameters and to substantiate conclusions. He has 44+ years at these activities. He has some sonar evaluation Independent Validation and Verification (IV&V) experience [22], [31]-[33]; has done Global Positioning System (GPS) integration Development Test and Evaluation (DT&E) in attack submarines and refereed the performance of the dual manufacturer Phase II **GPS receiver** competition between **Magnavox** and **Rockwell International** against Department of Defense (DoD) spec compliance [28], [36]-[39], [111], [125], [128] and investigated use of GPS in novel applications [105] as well. More recently he has worked in **strategic Radar target-tracking** [49], [100], [115]-[122], [127]; and in some aspects of tactical and strategic Electronic Warfare (EW) pattern recognition applications [29], [34] and in following recent gravity models, Inertial Navigation Systems, and proposed modifications in GPS receivers, respectively, as [134], [135], and [136]. He has taken 95+ Continuing Education courses and has over 130+ technical publications reporting his novel results and insights. Since 2000, he has generated 16 publications advertising **TeK Associates**' analysis capabilities and other software projects initiated and completed.

Technical Summary

Thomas H. Kerr III's experience for the past 40+ 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 Navy LAMPS Lofar/Difar AOT &PTA sonobuoys.
- Presented his analysis and simulation at Naval Academy & 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 (J-V-C, Multi-hypotheses Tests, Murty, and Auction Algorithm) to handling or solving the multi-target tracking problem.
- 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). Programmed simulation of all aspects in PL/1, ran test cases, analyzed outputs & 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 in their transactions elucidating these aspects. Results also presented at Institute of Navigation 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 EW Radar aspects too.
- Results of his trailblazing analysis and evaluation of multi-sensor data collection using INS/GPS equipped support platform in Airborne map-making 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 and supporting computer processing.
- 24 years Windows-based Software Development (prior 20 year experience was on mainframes).
- Surveyed and analyzed alternative Decentralized filtering approaches to identify those satisfying constraints possessed or exhibited 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 EW 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).

As an algorithm and signal processing specialist, he generally focuses on system aspects related to optimal estimation and Kalman filtering and associated models, in particular, to requisite further processing of state estimates related to detection and tracking. His work and research experience has encompassed: estimation applications with standard Gaussian white noises or with non-standard Poisson or other point-process doubly stochastic noises present (primarily in NAVIGATION and in RADAR and IR target tracking applications); spectral estimation in analyzing and emulating RADAR primary polarization (PP) and orthogonal polarization (OP) target signatures [49]; decentralized and multi-rate filters [19], [20], [35], [40], [42], [59], [92], [102], [109], [110]; mathematical modeling [3], [4], [111] and parameter identification for stochastic systems [1], [2], [8]; optimal search and screening [16], [27]; angle-only (i.e., bearings-only) tracking [69], [78], [81], [84], [87], [90], [107]; fault/failure detection in dynamical systems (and the mathematically identical areas of maneuver detection, change detection and/or incident detection) [7], [11], [12], [17], [26], [30], [40], [42], [60]-[62], [114], [130], [131], [132]; optimal-sensor-usage-alternation with a Kalman filter; determining Pareto-optimal strategies using the method-of-linear-combinations (for multicriteria optimization) [16], [21], [123], [126]; optimal control [124], [129]; algorithm convergence [3], [4], [12], [14], [16], [127], [135]; engineering analyses; trade-off analyses/trade studies [13], [16], [122], [127]; computational techniques [41], [44], [63], [98], [103], [124], [129], [133], [136]; control theory (modern state-space-based and classical frequency-domain-based approaches) [131], [134]; and the supporting underlying systems theory [14], [15], [30], [41], [43]-[45], [62], [100], [103], [124], [129], [131], [133], [134]. Almost all of the above were obtained as outcomes under application contracts. The more provocative recent investigations reported above were initiated and personally performed under **TeK Associates**' IR&D contracts.

He now guides **TeK Associates**, an engineering consulting and software development company, in developing their main software product: **TK-MIP™** (due for final release in 2019) and in pursuing Small Business Innovation Research (SBIR's) and subcontracts in the evolving areas of Kalman filter and Control applications for Navigation, Target Tracking, and for Image Processing and Sensor Fusion. During this time, he also taught Optimal Control and Kalman filters in the graduate E.C.E. Department at Northeastern Univ. in the evenings for four years (between 1990 and 1995). He is versed in FORTRAN77/90/95, PL/1, IBM Assembly Language, BASIC (GW), and PC **MatLab™/Simulink™** (16-bit ver. 4.2 and 32-bit vers. 5.3 to 6.5, 64-bit ver. R2019a **MatLab** and vers. 3.0.1 to 5.0 **Simulink**) and also has some experience with Neural Networks (NN) for pattern recognition applications [97] (but is a skeptic regarding use of NN's for pure control applications [108], [113]). His new forte is Visual Basic™ (vers. 3, 4, 5, 6, and some aspects of .NET) in conjunction with PowerBasic™ for truly compiled executables, *.exe's (ever since ver. 5), using VBX's/OCX's, DLL's, DDE, OLE/COM/DCOM/ COM+/ActiveX, and the Window's **API** for snappier performance on the PC under both Windows™ 95/98/Me and Windows™ NT/2000/XP/Vista/7/10 and the associated third party tools. He is involved in aspects of data acquisition for PC's (e.g., DMA, PCI, USB, Firewire, DAQ data acquisition cards, signal conditioning, and follows evolving VITA standards). He possesses the above mentioned software tools including a **MatLab-to-C cross-compiler** (ver. 3.0), Real-Time Workshop (for automatic **SimuLink-to-C compilation**) and a wide variety of **MatLab** toolboxes, which he has previously demonstrated for his students at Northeastern University. He has **InstallShieldExpress** ver. 2.01 and **InstallShield PackageForTheWeb** ver 1.3 and both **Wise Installer** ver. 8.12 and **PC-Install** ver. 7 but has the most experience with the Wise Installer. He is learning more about the SLICOT toolbox for **MatLab™** and has used cutting-edge COMSOL Multi-physics trial version 4.0 and is aware of its utility and ease-of-use for solving PDE's.

Since explicit analytic closed-form examples or counterexamples are useful for exposing existing problems or weaknesses in areas of control and estimation theory so that these unfortunate holes may be shored up in a timely fashion, he developed a complete methodology ([47], [48], [98], [99], [104], [112], [124], [129]) consisting of a catalog of analytic closed-form test cases for verifying general purpose control and estimation related software code implementations and has previously participated (through the Boston area IEEE Control Systems Society as chairman of the Steering Committee) in a run off competition/comparison in September 1993 between four local but nationally known Computer-Aided Control System Design (CACSD) vendors. The benefits of using these recommended or similarly justified test cases are the reduced computational expense incurred during software debug by using such low-dimensional test cases and the insight gained into software performance, as gauged against test problems of known closed-form solution behavior (so that adverse changes, say, in computing platform behavior, as with a new operating system, firmware, or patch, can be detected early on during s/w unit tests and regression tests).

Detailed Description of Prior Professional Experience

Since founding TeK Associates in Lexington, MA in October 1992, the following developments, processing tasks, and investigations were performed:

- For **Arête Associates**' Navy Airborne Remote Optical Spotlight System (**ACOSS**) Littoral Surveillance program in 2003, developed a Kalman filter-based covariance analysis program in **MatLab™** and exercised it in performing quantitative evaluations of the relative pointing accuracy provided by each of several alternative candidate INS platforms of 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 otherwise incurred with time due to inherent gyro drift rate characteristic of each INS candidate [135]..
- For **Boeing Company** in 2002, prepared solicited proposal to improve evaluation of any tracking filter used for NMD/GMD in the application below. (Papers [131] and [132] were outcomes.) http://www.tekassociates.biz/PriorSummer2003TeKCovarianceFidelityProposal.pdf
- Participated in developing the next generation Upgraded Early Warning Radar (UEWR) target tracking filters for National Missile Defense as a consultant, first, for **The MITRE Corporation** (via **Gemini Industries** BOA '97-'98) [115]-[118], then directly for **XonTech** ('98-'99) [119], and, subsequently, directly for **Raytheon**

under NMD/UEWR ('99-'00) [120]-[122], [127]. Personally developed Cramer-Rao lower bound evaluation analysis and implemented corresponding **MatLab™** software for gauging nonlinear filter performance and contributed on other tracking issues such as specifying and documenting corresponding Software Requirements Specifications for the Extended Kalman Filter and Batch filters being used and in writing the Tracking Notebook and other memos and reports such as investigating use of the Lambert algorithm versus Levenberg-Marquardt least squares fitting in determining when to include the second zonal harmonic of gravity to account for the oblateness of the earth rather than ignore it, and gained experience with Interactive Multiple Model (IMM) estimation.

- Performed the entire development of **TeK Associates**' primary commercial software product: **TK-MIP™**, its architecture, its graphics, coding, preliminary internal R&D, supporting software documentation, validation demos, and the many applications of TK-MIP that have appeared in recent textbook chapters [103]; IEEE AES and AC journal articles [104], [106], [113], [114]; GPS investigations [105], [111], [125], [126]; SPIE'96 [109], ICSPAT'95 [107], [108], ICSPAT'96 [110], DASC'97 [111], [112], ONR/GTRI Workshop [123], [124]; and SPIE'01 [128]-[130] articles.
- Prepared all SBIR's and other unsolicited proposals submitted by **TeK Associates** over the last 18 years and have tracked other analytic leads including relevant areas of wavelet/multi-resolution analysis, space-time processing/Wigner distributions, Neural Networks, higher order bi- and tri-spectral techniques, and Image processing/Sensor Fusion based on 2-D Kalman filtering related to use of partial differential equations (PDE's) [109], [110], [129].
- Kept abreast of cutting edge developments in Gravity Modeling, Inertial Navigation Systems, and GPS receiver developments (viz., [134], [135], and [136], respectively).
- Within the last 4 years, I developed deliverable MatLab software for OKSI and Aurora Flight Sciences.

Over the six years at Lincoln Laboratory of MIT (in Lexington, MA), the following signal processing tasks and investigations were performed:

- As a member of Group 53 concerned with passive and active infrared target tracking and pattern recognition (e.g., distinguishing Howitzers from tanks and armored personnel carriers) and image processing, investigated aspects of parallel processing research for Kalman filters and investigated Neural Network (NN) theory and applications [97] and in particular the opportunity for using Kalman filters to expedite NN learning in place of standard backpropagation. Group 53 had a flight facility for gathering IR measurement data and laser range data on targets in different geographical areas, at different altitudes, from different aspect angles, using alternative optical and radar sensors (for later ATR algorithm tuning by others). He applied his Kalman filter/navigation theory background in an 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 an airborne LASERNAV II Inertial Navigation System (INS) during data collection missions of the particular G-1 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, also seeks to be parsimonious by not overlapping too much (thus avoiding overly redundant data recording). He specified a procedure for pre-flight mission planning and data patch preparation and grooming via INS/GPS waypoint insertion and retro-reflector pre-placement (to expedite later scene alignment) to designate anticipated swath row boundaries of sensor footprint and introduced use of colored balloons (and other special end-of-row markers) to signal aircraft to initiate 3 minute 180^{o} turns for backsweep coverage of adjacent rows [94], [95], [101], [105].
- For Group 95, 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 RV wake signatures from (Kwajalein Islands) [49] *Tradex* wideband radar data. Also explored use of Matrix Spectral factorization computer program in conjunction with use of realization theory results on the same problem [47], [104]. *Tradex* radar uses coherent phase processing so data and algorithm formulations had to accommodate both real and imaginary complex processing. Validated software with synthetic data simulated as problems of known solution, then applied validated implementation to actual *Tradex* radar data (as recorded on magnetic tape) [50]-[53], [98], [99]. Same techniques were used in reverse to emulate signatures of real targets for purposes of enemy deception as an electronic decoy [47], [104].
- Participated as a 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 including the interaction and/or impact of evolutionary navigation, pointing, and triangulation technology associated with angles-only tracking (as with coordinated electro-optic sensors or with range-denied jammed radars) [54]-[57].
- Performed study to assess the utility of using two range-denied (i.e., 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 the effect [57], [58], [68], [69],

[78], [79], [81], [83], [86], [87], [90]. He developed a new computer program for this application. Prior errors in the methodology were diplomatically pointed out [107].

- Developed an Extended Kalman filter for RV target tracking [64], [70]-[76], [100] using either radar or passive optics measurements (exclusively or in combination). Took steps to make software that was developed to be 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 variance within adaptive tracking gates for associating received returns with proper target tracks. This was all for a detailed simulation. Generated detailed intermediate software design memos (already listed above) and unit tests [70], [71] 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 and for implementing the solutions, and of handling the related problem of multi-sensor fusion.

Over the six years at Intermetrics, Inc. **[more recently renamed AverStar and moved to Burlington, MA from Cambridge then absorbed by Titan then absorbed by L3]**, the following navigation, Kalman filtering, or signal-processing related investigations/tasks 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) [35], [40], and [42].
- Represented the U.S. government interests on a team that critiqued Kalman filter design and performance of early Magnavox version of Precise Integrated Navigation System (PINS) [32], as developed for Minesweepers.
- Developed test plans, procedures, checklists, guidelines, and rationale for evaluating shipborne performance of four commercial SATNAV receivers for Naval Ocean Systems Center (NOSC).
- Worked on IV&V and documented several security issues for WIS (WWMCCS Improved System, where WWMCCS is World Wide Military Command and Control System): relating to use of coaxial vs. triaxial cable/grounding; potential vulnerability of fiber optics links; addressed WASSO (i.e., system administrator) issues and concerns; wrote MLMR white paper on use of encryption vs. check sums; scoped initial version of overall security plan. Familiarity with Orange-, Green-, Yellow-, and Bluebooks. (*Obviously, this assignment had nothing to do with Kalman filters but, never-the-less, was extremely useful to him years later regarding how to properly handle passwords, do classified processing, do classified deletes, and the how's and why's of enabling encryption within TeK Associates' current* TK-MIP™ *software product.*)
- Surveyed and summarized how Phase II Global Positioning System (GPS) works and options/variations in cross-checking both contractors' compliance (and in tagging violations) during the Phase II demonstration and competition for follow-on Phase III [28].
- Worked on integration of Joint Tactical Information and Distribution System (JTIDS) Relative Navigation (RelNav) into aircraft/aircraft carriers [23]-[25] and JTIDS/GPS integration issues.
- Performed test and evaluation of data monitoring GPS Phase II integration on Strategic Submersible Nuclear attack submarine SSN701 *La Jolla* [36]-[39] and the susceptibility to detection by enemy surveillance [29] in its use of GPS.
- Found stable decentralized Kalman filter formulations for Navy JTIDS RelNav [18]-[20].
- Looked into aspects of pattern recognition algorithm refinement for helicopter Missile Warning System (MWS) [34] for Honeywell Electro-Optical and critiqued their design.
- Performed Independent Validation and Verification (IV&V) of MSM-ll [22], as used for Anti-Submarine Warfare (ASW) sonobuoy processing by Navy Light Airborne Multi Platform System (LAMPS) helicopters, P-3 Orion, and participating ships and in subsequent critiquing the development of Kalman filters for sonobuoy target tracking [31], [33].
- Plenty of experience at writing proposals for Intermetrics. Participated in Integrated Navigation System Simulation (INSS), Common Kalman Filter, Advanced Tactical Navigator (ATN) (Phase 2), as well as in several other navigation-related and non-navigation but avionics-related proposals such as those that fed into the Northrop/McDonnell Douglas YF-23 Advanced Tactical Fighter (ATF).
- Served as Technical Editor of *Navigation, The journal of the Institute of Navigation* (in his supervisor Stephen Gilbert's stead for a year: 1985-86) between Paul M. Janiczek resigning (after getting married} and the next permanent editor being installed.

Over the six years at The Analytic Sciences Corporation (TASC) [in Reading, MA, which became part of Litton but is now part of Northrop Grumman], the following navigation, Kalman filtering, and fault detection/signal-processing related investigations/tasks were performed:

- Posed and solved the problem of optimal navigation fix utilization for submarines in such a way that navigation accuracy is adequately satisfactory while exposure to enemy surveillance is minimized [13], [14], [21], and [106] (recent follow-ups: [123], [126]). Considerations also included associated sweep-rate exposure to enemy surveillance while taking augmenting navigation INS fixes and thwarting enemy ASW search procedures (i.e., countermeasures) [27].

- Developed a failure detection technique for monitoring performance of the Electrostatically Supported Gyro Monitor (ESGM) on Trident submarines. Used confidence regions, as previously developed by me [1], [2] and refined them for this application [5]-[7], [9]-[12], [17], and [26]. 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 (then SSM, now UNISYS in Great Neck, NY) to implement.

During the two years at 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 (e.g., a steam car) in ADA [3], [4] and fielded questions by phone from engineers at other GE locations seeking help in the use of ADA for their projects. Was not a help desk but was an analyst to decipher their problem.
- 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. Developed a large Assembly Language code for this application. Used hexadecimal, octal, binary conversions and associated arithmetic. Learned and exploited GE-PAC-30 architecture (possessing a standard Harvard Architecture).

Professional Affiliations: Institute of Electrical and Electronics Engineers (IEEE) Life Senior Member (Automatic Control, Aerospace and Electronic Systems, Information Theory, Signal Processing), American Institute of Aeronautics and Astronautics (AIAA) Guidance, Navigation, and Control (Associate Fellow), Institute of Navigation (ION) since 1981, SPIE, Life member of National Defense Industrial Association (NDIA), and, off and on: American Association for the Advancement of Science, Mathematical Association of America, American Statistical Association, Association for Computing Machinery, Visual Basic User's Group, Microsoft Developer's Network (Level 2), Instrumentation, Systems, and Automation Society (ISA), New England Chinese Information & Networking Association (NECINA).

Representative Publications:

1. Kerr, T. H., "Applying Stochastic Integral Equations to Solve a Particular Stochastic Modeling Problem," Ph.D. Thesis in the Department of Electrical Engineering, University of Iowa, Iowa City, Iowa, Jan. 1971.
2. Kerr, T. H., Eyman, E. D., and Loh, N. K., "Modeling a Particular Class of Multiple-Input/Multiple-Output Black Boxes with Stochastic Integral Equations and Specifying the Required Parameters," *Proceedings of the I.F.A.C. Symposium on Modeling and Identification*, Hague, Netherlands, 1973.
3. Kerr, T. H., "ADA70 Steady-State Initial-Value Convergence Techniques," General Electric Report, Technical Information Series No. 72 CRD095, Schenectady, NY, 1972.
4. Kerr, T. H., "A Simplified Approach to Obtaining the Steady-State Initial Conditions for Linear System Simulations," *Proceedings of the Fifth Annual Pittsburgh Conference on Modeling and Simulation*, 1974.
5. Fagan, J., Kerr, T. H., and Uttam, B., "Poseidon Improvement Studies," TASC Technical Report TR-315-1, Reading, MA, Jun. 1973 (Confidential) for Navy, SP-24 of Strategic Systems Project office (Crystal City, VA).
6. Kerr, T. H., "Poseidon Improvement Studies: Real-Time Failure Detection in the SINS/ESGM," TASC Report TR-418-20, Reading, MA, Jun. 1974 (Confidential) for Navy, Strategic Systems Project Office: SP-24.
7. Kerr, T. H., "A Two Ellipsoid Overlap Test for Real-Time Failure Detection and Isolation by Confidence Regions," *Proceedings of IEEE Conference on Decision and Control*, Phoenix, AZ, Dec. 1974.
8. Kerr, T. H., "A New Multivariate Cramer-Rao Inequality for Parameter Estimation (Application: Input Probing Function Specification)," *Proceedings of IEEE Conference on Decision and Control*, Phoenix, AZ, pp. 97-103, Dec. 1974.
9. Kerr, T. H., "Failure Detection in the SINS/ESGM System," TASC Report TR-528-3-1, Reading, MA, Jul. 1975 (Confidential) for Navy, SP-24.
10. Kerr, T. H., "Improving ESGM Failure Detection in the SINS/ESGM System (U)," TASC Report TR-678-3-1, Reading, MA, Oct. 1976 (Confidential) for Navy, SP-24.
11. 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 the local Dayton Chapter of the American Statistical Association, Fairborn, Ohio, pp. 98-127, Jun. 1976.
12. 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, pp. 509-535, Aug. 1977.
13. 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, Dec. 1977 (Confidential) for Navy, SP-24.
14. Kerr, T. H., "An Invalid Norm Appearing in Control and Estimation," *IEEE Transactions on Automatic Control*, Vol. AC-23, No. 1, Feb. 1978.
15. Kerr, T. H., "Three Important Matrix Inequalities Currently Impacting Control and Estimation Applications," *IEEE Transactions on Automatic Control*, Vol. AC-23, No. 6, Dec. 1978.
16. Kerr, T. H., "Improving C-3 SSBN Navaid Utilization," TASC Technical Information Memorandum TIM-1390-3-1, Reading, MA, Aug. 1979 (Secret) for Navy, SP-24.
17. Kerr, T. H., "Statistical Analysis of a Two Ellipsoid Overlap Test for Real-Time Failure Detection," *IEEE Transactions on Automatic Control*, Vol. AC-25, No. 4, pp. 762-773, Aug. 1980.
18. Kerr, T. H., "Stability Conditions for the RelNav Community as a Decentralized Estimator-Final Report," Intermetrics, Inc. Report No. IR-480, Cambridge, MA, 10 Aug. 1980, for NADC (Warminster, PA).

19. Kerr, T. H., and Chin, L., "A Stable Decentralized Filtering Implementation for JTIDS RelNav," *Proceedings of IEEE Position, Location, and Navigation Symposium (PLANS)*, Atlantic City, NJ, 8-11 Dec. 1980.
20. 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, NATO Advisory Group for Aerospace Research and Development, AGARDograph No. 256, Noordhoff International Publishing, Lieden, pp. 3-1 to 3-39, 1981.
21. 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 Jun. 1981. (Selected for reprinting *in Navigation: Journal of the Institute of Navigation*, Vol. 28, No. 4, pp. 263-285, Winter 1981-82).
22. Kerr, T. H., "Introduction to MSM-ll Independent Validation and Verification," Intermetrics Memo, Cambridge, MA, 30 Oct. 1981, for NADC.
23. Fiorino, T., and Kerr, T. H., "JTIDS RelNav Integration Analysis of CV, F-14A, and E-2C Platforms," Intermetrics Report No. IR-MA-l00, Cambridge, MA, 15 Jan. 1982, for NADC.
24. Wiederholt, L., Fiorino, T., and Kerr, T. H., "GPS/SNAIS Laboratory Data Reduction Program Requirements Document," Intermetrics Report No. IR-MA-lll, Cambridge, MA, 3 May 1982, for NADC.
25. Kerr, T. H., "Rationale for Covariance Analysis within NADC's GPS/CV Integration Effort," Intermetrics Report No. IR-MA-115, Cambridge, MA, 10 May 1982, for NADC.
26. Kerr, T. H., "False Alarm and Correct Detection Probabilities Over a Time Interval for Restricted Classes of Failure Detection Algorithms," *IEEE Transactions on Information Theory*, Vol. IT-28, No. 4, pp. 619-631, Jul. 1982.
27. 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 (ION)*, Cambridge, MA, 27-29 Oct. 1982.
28. Kerr, T. H., "Phase III GPS Integration; Volume 1: GPS U.E. Characteristics," Intermetrics Report IR-MA-177, Cambridge, MA, Jan. 1983, for Navair.
29. Kerr, T.H., "GPS/SSN Antenna Detectability," Intermetrics Report No. IR-MA-199, Cambridge, MA, 15 Mar. 1983, for NADC.
30. 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, pp. 966-977, 22-24 Jun. 1983.
31. Kerr, T. H., "Functional and Mathematical Structural Analysis of the Passive Tracking Algorithm (PTA)," Intermetrics Report No. IR-MA-208, Cambridge, MA, 25 May 1983, for NADC.
32. Kerr, T. H., and Rogers, R., "Report on PINS Filter Design Review (of Magnavox)," Intermetrics Memo, Cambridge, MA, 11 Aug. 1983, for NOSC (San Diego, CA).
33. Kerr, T. H., "Assessment of the Status of the Current Post-Coherent Localization Algorithm," Intermetrics Report No. IR-MA-319, 31 May 1984, for NADC.
34. Kerr, T. H., "Update to and Refinement of Aspects of Pattern Recognition Principles Used in the Missile Warning System (AN/AAR-47)," Intermetrics Report No. IR-MA-362, 15 Sep. 1983, for Honeywell Electro-Optical.
35. Carlson, N. A., Kerr, T. H., Sacks, J. E., "Integrated Navigation Concept Study," Intermetrics Report No. IR-MA-321, 15 Jun. 1984, for ITT (Nutley, NJ).
36. Kerr, T. H., "Navy GPS/SSN Phase II User Equipment DT&E Magnavox Modification Center (Mod Center) Test Report," 1 Jun. 1985, for NADC Code 4022.
37. Kerr, T. H., "Navy GPS/SSN Phase II User Equipment DT&E Rockwell-Collins Modification Center (Mod Center) Test Report," 1 Jun. 1985, for NADC Code 4022.
38. Kerr, T. H., "Navy GPS/SSN Phase II User Equipment DT&E Rockwell-Collins Developmental Test and Evaluation (Operational Readiness) [DT&E (OR)] Test Report," 10 Jun. 1985, for NADC Code 4022.
39. Kerr, T. H., "Magnavox Military Utility Test Report," 10 Jun. 1985, for NADC Code 4022.
40. 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 Jan. 1985.
41. Kerr, T. H., "The Proper Computation of the Matrix Pseudo-Inverse and Its Impact in MVRO Filtering," *IEEE Transactions on Aerospace and Electronic Systems*, Vol. AES-21, No. 5, Sep. 1985.
42. Kerr, T. H., "Decentralized Filtering and Redundancy Management for Multisensor Navigation," *IEEE Trans. on Aerospace and Electronic Systems*, Vol. AES-23, No. 1, pp. 83-119, Jan. 1987 (minor corrections appear on p. 412 of May and on p. 599 of Jul. 1987 issues of same journal).
43. 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, Sep.-Oct., 1987 (reply to and rebuttal by author in Vol. 12, No. 5, p. 767, Sep.-Oct. 1989 issue).
44. 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, N.Y., 1988.
45. Kerr, T. H., "Status of CR-Like Lower bounds for Nonlinear Filtering," *IEEE Transactions on Aerospace and Electronic Systems*, Vol. AES-25, No. 5, pp. 590-601, Sep. 1989 (Author's reply in Vol. AES-26, No. 5, pp. 896-898, Sep. 1990).
46. 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.
47. 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 Mar. 1989 (BSD [previously BMO] limited distribution).
48. Kerr, T. H., "An Analytic Example of a Schweppe Likelihood Ratio Detector," *IEEE Transactions on Aerospace and Electronic Systems*, Vol. AES-25, No. 4, pp. 545-558, Jul. 1989.

49. Kerr, T. H., "Multichannel AR Modeling for the Active Decoy (U)," MIT Lincoln Laboratory Report No. PA-499, Lexington, MA, Mar. 1987 Secret.
50. Kerr, T. H., "Meeting Report: Subcontractor Kick-off Meeting with Charles Therrien (NPS)," Group Memo No. 95.3155, Lincoln Laboratory, Lexington, MA, 18 Mar. 1987.
51. Kerr, T. H., "Meeting Report and Subsequent Status Update: June Technical Interchange Subcontractor Meeting with C. W. Therrien (NPS)," Group Memo No. 95.3277, Lincoln Laboratory, Lexington, MA, 27 Jul. 1987.
52. Kerr, T. H., "Meeting Report and Issues/Action Items: August Technical Interchange Subcontractor Meeting with C. W. Therrien (NPS)," Group Memo No. 95.3338, Lincoln Laboratory, Lexington, MA, 4 Sep. 1987.
53. Therrien, C. W., and Kerr, T. H., "Results of 2-D Spectrum and Correlation Analysis," Group Memo No. 95.3155, Lincoln Laboratory, Lexington, MA, 8 Sep. 1987.
54. Kerr, T. H., "Satellite Survivability: Identifying Areas for Simulation to Finely Calibrate the Effect of Satellite Evasive Maneuvers and its Possible Interaction with Navigation-Update No. 2," Group Memo No. 95.3882, Lincoln Laboratory, Lexington, MA, 8 Feb. 1988.
55. Kerr, T. H., and Kaufman, J., "Satellite Survivability: 3-D Geometric Update to the Prior 2-D Analysis of Bearings-Only Target Triangulation- Further Gauging the Deleterious Impact of Satellite Navigation/Attitude Uncertainties on Required Operational Performance," Group Memo No. 95.3560, Lincoln Laboratory, Lexington, MA, 30 Mar. 1988.
56. Kerr, T. H., "Satellite Survivability: Radar Tracking of Exoatmospheric Targets Using a Kalman Filter:-*Implementation Considerations for Simulation*," Group Memo No. 95.3608, Lincoln Laboratory, Lexington, MA, 31 May 1988.
57. Kerr, T. H., "Satellite Survivability: RV Target Tracking Using Triangulation from Two Coordinated but Range-Denied Radars using Kalman Filters-A Covariance Analysis-Based Approach," Group Memo No. 95.3664, Lincoln Laboratory, Lexington, MA, 1988.
58. Kerr, T. H., "Evaluation Results for Triangulation Performance Accuracy of RV Tracking by Two Range-Denied Radars," Group Memo No. 95.3699, Lincoln Laboratory, Lexington, MA, 29 Jul. 1988.
59. Kerr, T. H., "Comments on 'Estimation Using a Multirate Filter'," *IEEE Transactions on Automatic Control*, Vol. AC-34, No. 3, p. 384, Mar. 1989.
60. Kerr, T. H., "Comments on 'A Chi-Square Test for Fault Detection in Kalman Filters'," *IEEE Transactions on Automatic Control*, Vol. AC-35, No. 11, pp. 1277-1278, Nov. 1990.
61. Kerr, T. H., "A Critique of Several Failure Detection Approaches for Navigation Systems," *IEEE Transactions on Automatic Control*, Vol. AC-34, No. 7, pp. 791-792, Jul. 1989.
62. Kerr, T. H., "On Duality between Failure Detection and Radar/Optical Maneuver Detection," *IEEE Transactions on Aerospace and Electronic Systems*, Vol. AES-25, No. 4, pp. 581-583, Jul. 1989.
63. Kerr, T. H., "Fallacies in Computational Testing of Matrix Positive Definiteness/Semidefiniteness," *IEEE Transactions on Aerospace and Electronic Systems*, Vol. AES-26, No. 2, pp. 415-421, Mar. 1990.
64. Kerr, T. H., "Software Specification for an Extended Kalman Filter to Track Exoatmospheric Targets," Group Memo No. 95.3936, Lincoln Laboratory, Lexington, MA, 22 Dec. 1988.
65. Kerr, T. H., "Status of Common Extended Kalman Filter Software for Both Angle-Only Tracking and for Standard Tracking Based on Measurement of Range, Angle, and Perhaps Doppler," Group Memo No. 95.4106, MIT Lincoln Laboratory, Lexington, MA, 26 Apr. 1989.
66. Kerr, T. H., "Prof. Bar-Shalom's Lecture on Multi-target Tracking," Group Memo No. 95.3912, Lincoln Laboratory, Lexington, MA, 29 Nov. 1988.
67. Kerr, T. H., "Open Literature Criticism's of Prof. Bar-Shalom's Prior PDAF Approach to Multi-target Tracking (and its attempted rebuttal)," Group Memo No. 95.3917, Lincoln Laboratory, Lexington, MA, 2 Dec. 1988.
68. Kerr, T. H., "Overview of Conclusions on Using Fused-State Estimates Versus Fused-Measurements for Two Sensor Tracking," Group Memo No. 95.3918, Lincoln Laboratory, Lexington, MA, 5 Dec. 1988.
69. Kerr, T. H., "Some Issues Concerning Use of An Extended Kalman Filter for Angle-Only Target Tracking," Group Memo No. 95.3924, Lincoln Laboratory, Lexington, MA, 7 Dec. 1988.
70. Kerr, T. H., "Test Cases for Confirming Performance of f(x) and $\partial f / \partial x$ Evaluation Subroutines," Group Memo No. 95.3969, Lincoln Laboratory, Lexington, MA, 4 Jan. 1989.
71. Kerr, T. H., "Detailed Specification for the Calculation and Validation of Q in the EKF," Group Memo No. 95.3979, Lincoln Laboratory, Lexington, MA, 12 Jan. 1989.
72. Kerr, T. H., "Detailed Specification of the EKF Transition Matrix Calculation to be Used for Covariance Matrix Propagation," Group Memo No. 95.3993, Lincoln Laboratory, Lexington, MA, 19 Jan. 1989.
73. Kerr, T. H., "Specifying How to Extricate Prior Information Filter Form of Covariance Propagation Since EKF for Exoatmospheric RV Tracking is to Now Have Nonzero Process Noise Covariance Level Q," Group Memo No. 95.3996, Lincoln Laboratory, Lexington, MA, 20 Jan. 1989.
74. Kerr, T. H., "Detailed Specification of Measurement Iteration for the EKF," Group Memo No. 95.3989, Lincoln Laboratory, Lexington, MA, 18 Jan. 1989 (REVISED: 22 Feb. 1989).
75. Kerr, T. H., "Specifying Details of the EKF Propagation-Step State Estimate," Group Memo No. 95.4010, MIT Lincoln Laboratory, Lexington, MA, 1 Feb. 1989.
76. Kerr, T. H., "Details of the PASS 3 Conversion for EKF Development," Group Memo No. 95.4063, Lincoln Laboratory, Lexington, MA, 20 Mar. 1989.
77. Kerr, T. H., "A Proposed Approach for Quantifying Performance in Multi-target Tracking Applications Without Full Scale Implementation," Group Memo No. 95.4053, Lincoln Laboratory, Lexington, MA, 6 Mar. 1989.
78. Kerr, T. H., "Status of Common Extended Kalman Filter Software for both Angle-Only Tracking and for Standard Tracking Based on Measurement of Range, Angle, and Doppler," Group Memo No. 95.4106, Lincoln Laboratory, Lexington, MA, 25 Apr. 1989.
79. Kerr, T. H., "Status of Multi-target Tracking Investigation Pertaining to IROM," Group Memo No. 95.4157, Lincoln Laboratory, Lexington, MA, 26 May 1989.

80. Kerr, T. H., “Recent Update on a Proposed Approach for Quantifying Performance in Multi-target Tracking Applications Without Full Scale Implementation,” Group Memo No. 95.4191, Lincoln Laboratory, Lexington, MA, 5 Jul. 1989.
81. Kerr, T. H., “Issues Relating to Improving Angle-Only EKF Tracking Performance,” Group Memo No. 95.4190, Lincoln Laboratory, Lexington, MA, 5 Jul. 1989.
82. Kerr, T. H., “Formal Request for Missing Portion of Spec for EKF in Angle-Only Tracking Mode,” Group Memo No. 95.4194, Lincoln Laboratory, Lexington, MA, 7 Jul. 1989.
83. Kerr, T. H., “A Need for Further Clarification of EKF Initial Conditions for Angle-Only Tracking (AOT) Mode,” Group Memo No. 95.4199, Lincoln Laboratory, Lexington, MA, 11 Jul. 1989.
84. Kerr, T. H., “Seeking Answer to Question About Identity of Variable `E_t’ That Occurs in ‘Polynomial Fit’ Initialization Procedure to be Utilized by EKF in Angle-Only Tracking (AOT) Mode,” Group Memo No. 95.4208, Lincoln Laboratory, Lexington, MA, 18 Jul. 1989.
85. Kerr, T. H., “An External Perspective on Use of TeX and LaTeX for Technical Document Preparation,” Group Memo No. 95.4210, Lincoln Laboratory, Lexington, MA, 20 Jul. 1989.
86. Kerr, T. H., “Detailed Design for Software Implementation of Constrained Optimization to be Tacked on to the EKF (in the Angle-Only Tracking Mode) to Incorporate *A Priori* Knowledge of Allowable RV Velocities,” Group Memo No. 95.4225, Lincoln Laboratory, Lexington, MA, 28 Jul. 1989.
87. Kerr, T. H., “Overview of Problems and Proposed Corrections to Prior Lincoln Approach to EKF Initialization for Angle-Only Target Tracking,” Group Memo No. 95.4235, Lincoln Laboratory, Lexington, MA, 7 Aug. 1989 (Updated on 21 Aug. 1989).
88. Kerr, T. H., “Detailed Design for Software Implementation of Monte-Carlo Change-Case Capability and Summary Statistics Computation and their Test and Validation,” Group Memo No. 95.4230, Lincoln Laboratory, Lexington, MA, 2 Aug. 1989.
89. Kerr, T. H., “On the Rigorous Determination and Interpretation of Confidence Region Ellipsoids in Kalman Filter Applications,” Group Memo No. 95.4257, Lincoln Laboratory, Lexington, MA, 23 Aug. 1989.
90. Kerr, T. H., “Angle-Only Tracking,” slide presentation *for Reentry Systems Program Review* at Lincoln Laboratory, Lexington, MA, 10 Jan. 1989.
91. Kerr, T. H., “New Developments in Kalman Filter Theory,” invited slide presentation to faculty and graduate students at The University of Iowa, Iowa City, Iowa on 20 Apr. 1989.
92. Kerr, T. H., “Decentralized Filtering and Redundancy Management for Multisensor Navigation,” half day slide presentation as one of several primary lecturers, along with Peter Maybeck (AFIT), in an East Coast version of a Kalman Filter Technology intensive Short Course to have been given the week of 13 Nov. 1989 at the University of Maryland, College Park, MD (and to be repeated in subsequent years), as organized by C. T. Leondes (UCLA).
93. Kerr, T. H., “A Recent Technical Update to How Steady-State Gains Can be Computed for an Alpha-Beta-Gamma Tracker,” Group Memo No. 53.THK89-2, Lincoln Laboratory, Lexington, MA, 20 Nov. 1989.
94. Kerr, T. H., “Position Accuracy Considerations to Support Test Aircraft IR Measurements for a Realistic IR Data Base (that can later be exercised in numerous ways),” Group Memo No. 53.THK89-5, Lincoln Laboratory, Lexington, MA, 20 Nov. 1989.
95. Kerr, T. H., “Answer to Question of Whether INS also Needs Tilt Fixes (by Some Means) as Well as Standard Occasional Position Fixes/Updates,” Group Memo No. 53.THK89-7, Lincoln Laboratory, Lexington, MA, 5 Dec. 1989.
96. Kerr, T. H., “Status of Tri-Service Program to Establish Pod-Mounted GPS and Differential GPS Standard Equipment and Military Test Ranges (Across the Country) with GPS Differential Correction Broadcast Available,” Group Memo No. 53.THK89-9, Lincoln Laboratory, Lexington, MA, 13 Dec. 1989.
97. Kerr, T. H., “The Potential for Neural Networks to Relieve Critical Bottlenecks in Two Tactical Air Force Flight Areas,” Group Memo No. 53.THK89-10, Lincoln Laboratory, Lexington, MA, 13 Dec. 1989 (updated 1 Jan. 1990).
98. 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 Dec. 1989 (BSD [previously BMO] limited distribution).
99. Kerr, T. H., “A Constructive Use of Idempotent Matrices to Validate Linear Systems Analysis Software,” *IEEE Transactions on Aerospace and Electronic Systems*, Vol. AES-26, No. 6, pp. 935-952, Nov. 1990 (minor correction appears in Nov. 1991 issue).
100. Kerr, T. H., “Streamlining Measurement Iteration for EKF Target Tracking,” *IEEE Transactions on Aerospace and Electronic Systems*, Vol. AES-27, No. 2, Mar. 1991 (minor correction appears in Nov. 1991 issue).
101. Kerr, T. H., “Evaluation of Airborne Inertial Navigational Accuracy using PC-Based Kalman Filter Technology: Airborne LASERNAV II with usage options in external NAVAID type and frequency of fixes,” Lincoln Laboratory SLIDE PRESENTATION pre-transparencies, 31 Oct. 1991.
102. Kerr, T. H., “Comments on ‘Federated Square Root Filter for Decentralized Parallel Processes’,” *IEEE Transactions on Aerospace and Electronic Systems*, Vol. AES-27, No. 6, Nov. 1991.
103. 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, 1993.
104. Kerr, T. H., “Emulating Random Process Target Statistics (using MSF),” *IEEE Transactions on Aerospace and Electronic Systems*, Vol. AES-30, No. 2, pp. 556-577, Apr. 1994.
105. 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, UT, pp. 1173-1188, 20-23 Sep. 1994.
106. Kerr, T. H., “Further Comments on ‘Optimal Sensor Selection Strategy for Discrete-Time Estimators’,” *IEEE Trans. on Aerospace and Electronic Systems*, Vol. 31, No. 3, pp. 1159-1166, Jun. 1995.
107. 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 (ICSPAT)*, Boston, MA, pp. 1574-1587, 24-26 Oct. 1995.

108. Kerr, T. H., "A Critique of Neural Networks as Currently Exist for Control and Estimation," *Proceedings of the International Conference on Signal Processing Applications & Technology (ICSPAT)*, Boston, MA, pp. 1434-1443, 24-26 Oct. 1995.
109. Kerr, T. H., "Extending Decentralized Kalman Filtering (KF) to 2-D for Real-Time Multisensor Image Fusion and/or Restoration," Signal Processing, Sensor Fusion, and Target Recognition V, *Proceedings of SPIE Conference*, Vol. 2755, Orlando, FL, pp. 548-564, 8-10 Apr. 1996.
110. 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 (ICSPAT96)*, Boston, MA, 7-10 Oct. 1996.
111. Kerr, T. H., "A Critical Perspective on Some Aspects of GPS Development and Use," *Proceedings of 16th Digital Avionics System Conference*, Vol. II, pp. 9.4-9 to 9.4-20, Irvine, CA, 26-30 Oct. 1997
112. Kerr, T. H., and Satz, H., S., "Applications of Some Explicit Formulas for the Matrix Exponential in Linear Systems Software Validation," *Proceedings of 16th Digital Avionics System Conference*, Vol. I, pp. 1.4-9 to 1.4-20, Irvine, CA, 26-30 Oct. 1997.
113. Kerr, T. H., "Critique of Some Neural Network Architectures and Claims for Control and Estimation," *IEEE Transactions on Aerospace and Electronic Systems*, Vol. AES-34, No. 2, pp. 406-419, Apr. 1998. (Extends beyond prior version [108] above).
114. Kerr, T. H., "Comments on 'An Algorithm for Real-Time Failure Detection in Kalman Filters'," *IEEE Trans. on Automatic Control*, Vol. 43, No. 5, pp. 682-683, May 1998.
115. Kerr, T. H., *NMD White Paper on Designated Action Item*, MITRE, Bedford, MA, Jan. 1998.
116. 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.
117. 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, Feb. 1998.
118. 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 Aug. 1998.
119. 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 Mar. 1999.
120. 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 Nov. 1999.
121. 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 Sep. 2000.
122. 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 Sep. 2000.
123. Kerr, T. H., "Sensor Scheduling in Kalman Filters: varying navaid fixes for trading-off submarine NAV accuracy vs. ASW exposure," *Proceedings of The Workshop on Estimation, Tracking, and Fusion:* A Tribute to Yaakov Bar-Shalom (on the occasion of his 60th Birthday) following the *Fourth ONR/GTRI Workshop on Target Tracking and Sensor Fusion*, Naval Postgraduate School, Monterey, CA, 17 May 2001.
124. Kerr, T. H., "Verification of Linear System Software Sub-Modules using Analytic Closed-Form Results," *Proceedings of The Workshop on Estimation, Tracking, and Fusion:* A Tribute to Yaakov Bar-Shalom (on the occasion of his 60th Birthday) following the *Fourth ONR/GTRI Workshop on Target Tracking and Sensor Fusion*, Naval Postgraduate School, Monterey, CA, 17 May 2001.
125. 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.
126. 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 Jun. 2001.
127. 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 Jul. 2001 (Unclassified paper but Conference Proceedings are SECRET).
128. 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 Jul.-3 Aug. 2001.
129. 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, CA, 29 Jul.-3 Aug. 2001.
130. 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 Jul.-3 Aug. 2001.
131. Kerr, T. H., "Comments on 'Determining if Two Solid Ellipsoids Intersect'," *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 28, No. 1, pp. 189-190, Jan.-Feb. 2005.
132. 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
133. Kerr, T. H., **"**The Principal Minor Test for Semidefinite Matrices-Author's Reply**,"** *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 13, No. 3, p. 767, Sep.-Oct. 1989.
134. Kerr, T. H**.**, **"**Comments on 'Precision Free-Inertial Navigation with Gravity Compensation by an Onboard Gradiometer'**,"** *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 30, No. 4, pp. 1214-1215, Jul.-Aug. 2007.
135. Kerr, T. H., **"**Novel Variations on Old Architectures/Mechanizations for New Miniature Autonomous Systems**,"** *Online Proceedings of GMC MAS 2009 Conference*, Session E1: Controlling Miniature Autonomous Systems, Ft. Walton Beach, FL, 28 October 2009.

136. Kerr, T. H., **"**Comment on 'Low-Noise Linear Combination of Triple-Frequency Carrier Phase Measurements'**,"** *Navigation: Journal of the Institute of Navigation*, Vol. 57, No. 2, pp. 161, 162, Summer 2010.

The above publications are frequently cited by other independent authors and researchers worldwide thus endorsing their significance. To verify this claim, please use Web of Science Citations Index searches under Kerr, T. H. Unfortunately, Microsoft Academic Search has not yet caught up to many of my engineering publications at https://academic.microsoft.com/#/detail/2424976702 but Google Scholar has done a better job of keeping up with them: https://scholar.google.com/citations?user=UjaYY4EAAAAJ&hl=en.

Significant original development in submarine navigation trade-off considerations between frequency of external navaid fix usage (maintaining sufficient navigation accuracy in case a launch is ordered) vs. exposure to enemy surveillance while taking these navaid fixes:

- 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, Dec. 1977 (Confidential).
- Kerr, T. H., "Improving C-3 SSBN Navaid Utilization," TASC TIM-1390-3-1, Reading, MA, Aug. 1979 (Secret).
- 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 Jun. 1981 (reprinted in *Navigation: Journal of the Institute of Navigation*, Vol. 28, No. 4, pp. 263-285, Winter 1981-82).
- Kerr, T. H., "Sensor Scheduling in Kalman Filters: varying navaid fixes for trading-off submarine NAV accuracy vs. ASW exposure," *Proceedings of The Workshop on Estimation, Tracking, and Fusion:* A Tribute to Yaakov Bar-Shalom (on the occasion of his 60th Birthday) following the *Fourth ONR/GTRI Workshop on Target Tracking and Sensor Fusion*, Naval Postgraduate School, Monterey, CA, 17 May 2001.
- 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 Jun. 2001.

Publications where he developed Two Confidence Region (CR2) Failure Detection:

- Kerr, T. H., "Poseidon Improvement Studies: Real-Time Failure Detection in the SINS/ESGM," TASC Report TR-418-20, Reading, MA, Jun. 1974 (Confidential).
- Kerr, T. H., "Failure Detection in the SINS/ESGM System," TASC Report TR-528-3-1, Reading, MA, Jul. 1975 (Confidential).
- Kerr, T. H., "Improving ESGM Failure Detection in the SINS/ESGM System (U)," TASC Report TR-678-3-1, Reading, MA, Oct. 1976 (Confidential).
- 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, Jun. 1976.
- 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, Aug. 1977.
- Kerr, T. H., "Statistical Analysis of a Two Ellipsoid Overlap Test for Real-Time Failure Detection," *IEEE Transactions on AC*, Vol. 25, No. 4, Aug. 1980.
- 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, Jul. 1982.
- 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 Jun. 1983.
- 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, Nov. 1990.
- Kerr, T. H., "A Critique of Several Failure Detection Approaches for Navigation Systems," *IEEE Transactions on AC*, Vol. 34, No. 7, pp. 791-792, Jul. 1989.
- Kerr, T. H., "On Duality Between Failure Detection and Radar/Optical Maneuver Detection," *IEEE Transactions on AES*, Vol. 25, No. 4, pp. 581-583, Jul. 1989.
- 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.
- 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.

Publications addressing Decentralized Kalman Filtering:

- Kerr, T. H., “Stability Conditions for the RelNav Community as a Decentralized Estimator-Final Report,” Intermetrics, Inc. Report No. IR-480, Cambridge, MA, 10 Aug. 1980
- 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 Dec. 1980.
- 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.
- Carlson, N. A., Kerr, T. H., Sacks, J. E., “Integrated Navigation Concept Study,” Intermetrics Report No. IR-MA-321, 15 Jun. 1984.

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

- 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 Jan. 1985.
- Kerr, T. H., “Decentralized Filtering and Redundancy Management for Multisensor Navigation,” *IEEE Trans. on AES*, Vol.23, No. 1, pp. 83-119, Jan. 1987.

Evidence of Technical Accomplishment

- Personally trailblazing R&D development of the Kalman filter-based *Two Confidence Region Failure Detection* proceeding from first principles and carrying it elegantly to fruition.
- He surveyed many historical approaches to decentralized filtering and narrowed down to identify those few that rigorously satisfied reasonableness constraints possessed by the Joint Tactical Information and Distribution System (JTIDS) and Integrated Communications Navigation and Identification in Avionics (ICNIA) applications that motivated his investigation.
- Ground breaking insight was exhibited in his leaping to realize the utility of combining his earlier “failure detection methodologies” with the results of his later investigation into “decentralized estimation”, thus reaping a satisfying firm theoretical foundation for “redundancy management” for navigation applications.

He has published three book chapters:

- 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.
- 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;
- 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 3 of the above discussions specifically pertain to aspects of Kalman filtering. He has 10 additional publications that relate to underlying numerical computational details, all arising in Kalman filters, and has published application results for another 11 distinctly different Kalman filter implementation areas.

He has sufficient breadth to analyze other issues such as GPS Status, GPS integration, Sonobuoy passive target tracking, Surveillance sweeprates, and Neural Networks:

- 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.
- Kerr, T. H., “Phase III GPS Integration; Volume 1: GPS U.E. Characteristics,” Intermetrics Report IR-MA-177, Cambridge, MA, Jan. 1983.
- Kerr, T.H., “GPS/SSN Antenna Detectability,” Intermetrics Report No. IR-MA-199, Cambridge, MA, 15 Mar. 1983
- Kerr, T. H., “Assessment of the Status of the Current Post-Coherent Localization Algorithm,” Intermetrics Report No. IR-MA-319, 31 May 1984.
- Kerr, T. H., “An Analytic Example of a Schweppe Likelihood Ratio Detector,” *IEEE AES Transactions*, Vol. 25, No. 4, pp. 545-558, Jul. 1989.
- Kerr, T. H., “Critique of Some Neural Network Architectures and Claims for Control and Estimation,” *IEEE AES Transactions*, Vol. 34, No. 2, pp. 406-419, Apr. 1998.
- 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

- Kerr, T. H., **"**Comments on 'Precision Free-Inertial Navigation with Gravity Compensation by an Onboard Gradiometer'**,"** *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 30, No. 4, pp. 1214-1215, Jul.-Aug. 2007.
- Kerr, T. H., **"**Novel Variations on Old Architectures/Mechanizations for New Miniature Autonomous Systems**,"** *Online Proceedings of GMC MAS 2009 Conference*, Session E1: Controlling Miniature Autonomous Systems, Ft. Walton Beach, FL, 28 October 2009.
- Kerr, T. H., **"**Comment on 'Low-Noise Linear Combination of Triple-Frequency Carrier Phase Measurements'**,"** *Navigation: Journal of the Institute of Navigation*, Vol. 57, No. 2, pp. 161, 162, Summer 2010.

IEEE Activities – Awards, Offices Held, Committee Memberships:

- 1975 Vice-Chairman of Stochastic Control Session at Conference on Decision and Control (CDC);
- 1988 M. Barry Carlton Award from IEEE Aerospace and Electronics Systems for Outstanding Paper in 1987;
- 1990-1992 Chairman of local Boston section of Control System Society;
- 1992-1994 Chairman of Steering Committee of local Boston section of Control System Society;
- 1995-1996 Vice-Chairman of local Boston section of Control System Society;
- 1997-1998 At-large member of Steering Committee of local Boston section of Control System Society;
- 2002-2004 Chairman of local Boston section of Control System Society (again);
- 2006 Served on local IEEE Committee for selecting new Senior Members;
- Has served as paper reviewer numerous times for IEEE Transactions on AC, IT, AES, SMC, Computer Science and for AIAA Journal of Guidance, Control, and Dynamics over the years.
- Made a Life Senior Member in 2011 (already received certificate and corresponding card in Oct. 2010).

Non-IEEE Activities, Awards, Professional Society Memberships, Committee Memberships

- Qualified and joined honor societies: Tau Beta Pi, Eta Kappa Nu, Sigma Pi Sigma, Pi Mu Epsilon (student president), Sigma Xi;
- 1966–1967 Tutored *Calculus*, *Dynamics*, and *Strength of Materials* as undergraduate. Tutored Circuit Theory in Graduate School (1970);
- 1967 Who's Who in American Schools and Colleges;
- 1967 $340 Student Prize Paper Award sponsored by Federal Power Commission for local engineering schools in the Washington D.C. area;
- 1971–1973 Tutored mathematics at Union College and at Schenectady, NY Community Center;
- 1973 –1975 Tutored mathematics at Union Methodist Church in Boston, MA;
- National Defense Industrial Association (NDIA) member since 1982. NDIA Life member since 1992;
- In 1990's, gave invited lectures at University of Iowa (Iowa City), University of Connecticut, University of Maryland (Baltimore), and West Virginia University;
- 1980 AIAA GNC (Senior Member); Received AIAA GCD 25 year certificate (2005); Became an Associate Fellow of AIAA GNC (Jan. 2012);
- Member of Institute of Navigation (ION) since 1981 (served as interim ION Journal editor in 1985-1986);
- Served as Co-chairman of "Sensors, Components, and Algorithms for Navigation" session at the Institute of Navigation (ION) *Annual Summer Conference* (1999) in Cambridge, MA;
- Member of American Association for the Advancement of Science, Association of Computing Machinery, SPIE, National Defense Preparedness Association (life member), Mathematical Association of America, American Statistical Association, Microsoft Developer Network (MSDN) level 2;
- *Who's Who in the East* ('92), *in Technology* ('93), *in the World* ('98), *in the USA* ('03), *in Finance and Business* ('05), and *in Science and Engineering* ('06), and in Who's Who ('10). Listed in Global Register's *Who's Who of Executives and Professionals* in '05;
- Ride leader for Charles River Wheelmen long distance bicycling club (1990-'97). A CRW member since 1977.