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) 999-1530 (Cell)
PERSONAL DATA	Citizenship: U.S.	Held Secret DOD Clearance: 1973-'01 Held Wintel Clearance: 1986-'01 Interim Secret Clearance Re-activated by GCR via "eqip" in Oct. 2019. Continued by Zivaro 2022-Present: '24 including NORAD & NATO Secret and how to properly handle **CUI** info.
Married with two adult sons	Birth date: 9 November 1945	His paternal grandfather continued to work as a pharmacist well past 70.
EDUCATION		
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 Classical & Modern 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
PROFESSIONAL EXPERIENCE		
From (year) to (year)	**Name of Company**	**Position Held**
06/21/2022-07/14/2023	**Exclusively for Zivaro, Inc. (Partnered with JACOBS) in Colorado Springs, CO**	**Algorithm Engineer (Performing Strategic Consulting for Space Force Office of the Chief Scientist)**
06/17/2019-11/01/2019	**GCR at Draper Laboratory (Cambridge, MA)**	**Contractor: Senior GNC Analyst**
10/2012-5/2013	**Adecco at Goodrich ISR (Westford, MA)**	**Contractor: Systems Engineer for U-2S SYERS Camera Pointing accuracy**
04/09/07-04/08/2009	**Kelly Services at Google Books (Lexington, MA)**	**Contractor: Quality Assurance (QA) operator for 2-D images**
1992-6/21/2022 but was on hiatus while at Zivaro, Inc., above. Resumed all prior roles: 09/2023-Present	**TeK Associates (Lexington, MA, now in Woburn, MA)**	**CEO/Principal Investigator/Chief Programmer/Owner**
1990-1995 (evenings only)	**Northeastern University Graduate ECE Dep.t (Boston)**	**Instructor in Optimal Control and Kalman Filtering (for 4 yrs)**
1986-1992	**Lincoln Laboratory of MIT (Lexington, MA)**	**Member of the Technical Staff**
1979-1986	**Intermetrics, Inc (Cambridge, MA)**	**Senior Systems Analyst/Systems Engineer**
1973-1979	**The Analytic Sciences Corporation (Reading,MA)**	**Member of the Technical Staff**
1971-1973	**General Electric Corporate R&D Center (Schenectady, NY)**	**Control Engineer**
1969-1971	**University of Iowa (Iowa City, IA)**	**Research Assistant/Teaching Assistant (as a graduate student, working toward M.S.E.E. and Ph.D.)**
1967	**Howard University (Wash, D.C.)**	**Research Assistant (part of senior year) and during whole summer after graduating [while also attending George Washington University at night.]**

He is now d.b.a. TeK Associates
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https://blogs.mathworks.com/headlines/2016/09/08/this-56-year-old-algorithm-is-key-to-space-travel-gps-vr-and-more/ (click comments on prior link to see his 20 entries) https://www.researchgate.net/profile/Thomas_Kerr_Iii
https://www.linkedin.com/in/thomaskerriiikalmanfiltermaven https://academic.microsoft.com/#/detail/2424976702
https://scholar.google.com/citations?user=UjaYY4EAAAAJ&hl=en (To return to this point **afterwards** to resume reading, merely use the **back arrow** at the **top left** of your **Web Browser** or keyboard: **ALT + Left Arrow**.)

Dr. Thomas H. Kerr III's experience for the past 50+ 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 in my opinion]) with careful assessment of associated computational burdens and delay.
  -with hopes for benefits in parallelization (multi-threaded parallel processing and/or embedded apps).
- Design, Evaluation, and Implementation of **A**ngle-**o**nly **t**racking (**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), **M**atrix **S**pectral **F**actorization (**MSF**), and **C**ramer-**R**ao **L**ower **B**ound (**CRLB**) evaluation.
- Event detection (e.g., via use of **G**eneralized **L**ikelihood **R**atio [**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, **R**eceiver **A**utonomous **I**ntegrity **M**onitoring [**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 48 years on DoD applications: (Poseidon/Trident) **submarines** navigation failure detection 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. He has worked on Air Force **aircraft Navigation failure detection and reconfiguration** in Navigation systems within owncraft position and attitude determination. In performing design and analysis for the aforementioned application, 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 **I**ndependent **V**alidation and **V**erification (**IV&V**) experience; has done **G**lobal **P**ositioning **S**ystem (**GPS**) integration **D**evelopment **T**est and **E**valuation (**DT&E**) in attack submarines and refereed the performance of the dual manufacturer Phase II **GPS receiver** competition between **Magnavox** and **Rockwell International** against **D**epartment **o**f **D**efense (**DoD**) spec. compliance and investigated use of GPS in novel applications as well as more recently working in **strategic Radar target-tracking** and in some aspects of tactical and strategic Electronic Warfare (EW) pattern recognition applications and in following recent gravity models, Inertial Navigation Systems, and proposed modifications in GPS receivers, respectively. He has taken 95+ Continuing Education courses and has over 130+ technical publications reporting his novel results and insights: httsp://www.tekassociates.biz/thkpublications.pdf.

Technical Summary

Thomas H. Kerr III’s experience for the past 50+ 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 vs. exposure to enemy surveillance incurred while 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). Coded simulation of all aspects in PL/1, ran test cases.

•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 & Electronics Systems for his publication in their transactions elucidating these aspects. Results also presented at Institute of Navigation Conference. Ultimately spawning 11 patents by others identified by IEEE.

•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).

•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).

•At Zivaro, Inc. (Partnered with JACOBS), Provided Strategic Consulting to the Office of the Chief Scientist for aspects pertaining to Space Force concerns from 21 June 2022 until 14 July 2023: Applied GNU Octave to verify Positive Definiteness of simulated covariances of a particular sensor of interest (before encoding, after encoding, and after decoding); Applied MatLab to classified real data calculations performed at **T**est and **D**evelopment **F**acility (TDF) in obtaining similar results; Summarized 2017 ed. of MAS SRS for this same sensor in analyzing what is needed to be included in computing Target Impact Ellipse; Found relevant existing warnings by Iron Dome analyst to better handle EKF trackers being used with Phased Array Antennas; Provided data fusion ideas (based on Decentralized Kalman Filter precepts) by merely adding (6 x 1) vectors obtained from sensors at different locations using interpolation in time.

As an algorithm and signal processing specialist, Thomas Kerr III 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 some 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; decentralized and multi-rate filters; mathematical modeling and in parameter identification for stochastic systems; optimal search and screening; angle-only (i.e., bearings-only) tracking; fault/failure detection in dynamical systems (and the mathematically identical areas of maneuver-detection, change-detection and/or incident-detection); optimal-sensor-usage-alternation in use of a Kalman filter; determining Pareto-optimal strategies using the method-of-linear-combinations (for multicriteria optimization); optimal control; algorithm convergence; engineering analyses; trade-off analyses/trade-studies; computational techniques; control theory (modern state-space-based and classical frequency-domain-based PID feedback approaches); and the supporting underlying systems theory. Almost all the above were obtained as outcomes under application contracts.

Tom Kerr now guides his one man company, **TeK Associates**, an engineering consulting and software development company, in developing their main software product: **TK-MIP™** (due for final release in 2023) 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). httsp://www.tekassociates.biz/#SoftwareResources and also has some experience with Neural Networks (NN) for pattern recognition applications (but is a skeptic regarding use of NN's for pure control applications). 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 Windows™ and the associated VB third-party tools. He is involved in aspects of data acquisition for PC's (e.g., DMA, PCI, USB, 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 (but not in real-time).

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 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 **C**omputer-**A**ided **C**ontrol **S**ystem **D**esign (**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**).

<u>Detailed Description of Prior Professional Experience</u>

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

- For **Arête Associates**' Navy **A**irborne **R**emote **O**ptical **S**potlight **S**ystem (**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 ..
- For **Boeing Company** in 2002, prepared solicited proposal to improve evaluation of any tracking filter used for NMD/GMD in: http://www.tekassociates.biz/PriorSummer2003TeKCovarianceFidelityProposal.pdf
- Participated in developing the next generation **U**pgraded **E**arly **W**arning **R**adar (**UEWR**) target tracking filters for **N**ational **M**issile **D**efense as a consultant, first, for **The MITRE Corporation** (via **Gemini Industries** BOA '97-'98)], then directly for **XonTech** ('98-'99), and, subsequently, directly for **Raytheon** under **NMD/UEWR** ('99-'00). 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 **I**nteractive **M**ultiple **M**odel **(IMM**) bank-of-Kalman-Filters 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; IEEE AES and AC journal articles; GPS investigations; SPIE'96, ICSPAT'95, ICSPAT'96, DASC'97, ONR/GTRI Workshop; and SPIE'01 articles.
- He prepared all SBIR's and other unsolicited proposals submitted by **TeK Associates** over the last 30 years and has tracked other analytic leads including relevant areas of wavelet/multi-resolution analysis, space-time adaptive processing/Wigner distributions, Neural Networks, higher order bi-spectral and tri-spectral techniques, and Image processing/Sensor Fusion based on 2-D Kalman filtering related to use of PDE's rather than ODE's.
- Kept abreast of cutting-edge developments in Gravity Modeling, Inertial Navigation Systems, and GPS receiver developments.
- Within the last 6 years, he developed deliverable MatLab software for **OKS**I 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 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 Grumman 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 180º turns for backsweep coverage of adjacent rows.
- 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) *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. *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). Same techniques were used in reverse to emulate signatures of real targets for purposes of enemy deception as an electronic decoy.
- 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).
- 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. I developed a new computer program for this application. Prior errors in the methodology were diplomatically pointed out.
- Developed an Extended Kalman filter for RV target tracking 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 false target reports for nonexistent targets. 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 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 and for implementing the solutions, and of alternatives for 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 L3Harris]**, the following navigation, Kalman filtering, or signal-processing related investigations/tasks were performed:

- Pioneered failure detection/redundancy management/decentralized filter formulations as developed under **I**ntegrated **C**ommunications, **N**avigation, and **I**dentification for **A**vionics (**ICNIA**) for the **A**dvanced **T**actical **F**ighter (**ATF**).
- 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), 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 I**mproved **S**ystem, where **WWMCCS** is **W**orld **W**ide **M**ilitary **C**ommand and **C**ontrol **S**ystem): 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 *Blue*-books. (*Obviously, this assignment had nothing to do with Kalman filters but, never-the-less, was extremely useful to Tom Kerr 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 G**lobal **P**ositioning **S**ystem (**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**.
- 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 **S**trategic **S**ubmersible **N**uclear attack submarine **SSN**701 *La Jolla* and the susceptibility to detection by enemy surveillance in its use of GPS.
- Found stable decentralized Kalman filter formulations for Navy **JTIDS RelNav**.
- Looked into aspects of pattern recognition algorithm refinement for helicopter Missile Warning System (MWS) [34] for Honeywell Electro-Optical and critiqued their design.
- Performed **I**ndependent **V**alidation and **V**erification (**IV&V**) of MSM-ll, as used for **A**nti-**S**ubmarine **W**arfare (**ASW**) sonobuoy processing by Navy **L**ight **A**irborne **M**ulti **P**latform **S**ystem (**LAMPS**) helicopters, P-3 *Orion*, and other participating ships and in my subsequent critiquing the development of various Kalman filters for sonobuoy target tracking.
- Plenty of experience at writing proposals for Intermetrics. Participated in Integrated Navigation System Simulation (INSS), Common Kalman Filter, **A**dvanced **T**actical **N**avigator (**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 A**dvanced **T**actical **F**ighter (**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 previous editor, Paul M. Janiczek, resigning (after his 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:

- I posed and solved 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 while taking augmenting navigation INS fixes and thwarting enemy **A**nti-**S**ubmarine **W**arfare (**ASW)** search procedures (i.e., countermeasures).
- Developed a failure detection technique for monitoring performance of the recently introduced **E**lectrostatically **S**upported **G**yro **M**onitor **(ESGM**) on Trident submarines. Used confidence regions, as previously developed by me in my 1971 Ph.D. thesis, and refined them for this particular application. I 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 in their candidate mission software.

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 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: **https://www.tekassociates.biz/index.html#ProfessionalAffiliations**

His 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: 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:
https://www.tekassociates.biz/#ObservablesTradeOffSurveilanceExposureVsNAVAccuracy

Publications where he developed Two Confidence Region (CR2) Failure Detection:
https://www.tekassociates.biz/index.html#DevelopingTwoConfidenceRegionApproachToFailureDetection

Publications addressing Decentralized Kalman Filtering:
https://www.tekassociates.biz/index.html#CriticismsofNonKalmanFilterApproaches

His publications that combine the ideas of failure detection with those of decentralized Kalman Filtering to yield a breakthrough rigorous basis for redundancy management:
https://www.tekassociates.biz/index.html#HandlingBothFailureDetectionAndDecentralizedFilters

Evidence of Technical Accomplishment –Honors and Awards:
https://www.tekassociates.biz/index.html#HonorsAwards

He has published three book chapters:
https://www.tekassociates.biz/index.html#Published3BookChaptersOnKalmanFilterAspects

He has sufficient breadth to analyze other issues such as GPS Status, GPS integration, Sonobuoy passive target tracking: http://www.tekassociates.biz/#DepthandBreadth
https://www.tekassociates.biz/index.html#CriticismsofNonKalmanFilterApproaches

IEEE Activities – Awards, Offices Held, Committee Memberships:
https://www.tekassociates.biz/index.html#IEEEActivities

Non-IEEE Activities, Awards, Professional Society Memberships, Committee Memberships
https://www.tekassociates.biz/index.html#NONIEEEActivities

Thomas H. Kerr III's Awareness of important NASA Views & Constraints:
https://ntrs.nasa.gov/api/citations/19770015864/downloads/19770015864.pdf Sensors to be used in NASA space applications are characterized in Chapter 5 and overall usage further below:
https://www.nasa.gov/smallsat-institute/sst-soa-2020/guidance-navigation-and-control
General principles applicable in the space application domain are covered in State of the Art of Small Spacecraft Technology: https://www.nasa.gov/smallsat-institute/sst-soa-2020
More on the Lambert Problem here and here and below:
https://en.wikipedia.org/wiki/Lambert%27s_problem Multiple Revolution Perturbed Lambert Problem Solvers: https://arc.aiaa.org/doi/10.2514/1.G003531
https://www.coursehero.com/file/18957977/4-Ch-7-Lamberts-Problem-r1/
For 3 Body and Restricted 3 Body Problems: https://en.wikipedia.org/wiki/Three body_problem and for (the five) Lagrange Points: https://en.wikipedia.org/wiki/Lagrange_point