

Unsettled Topics in the Application of Satellite Navigation to Air Traffic Management

James L. Farrell, Ph.D.

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About the Editor



James L. Farrell earned his MS in Engineering from UCLA in 1961 and his Ph.D. in Electrical Engineering from the University of Maryland in 1967. He is an Institute of Navigation (ION) fellow, former ION Air Representative, Life Senior Member of IEEE, former local board member of AIAA, registered professional engineer in Maryland, and member of various scholastic honorary fraternities. His technical experience includes teaching at Marquette University and UCLA, two years each at Minneapolis Honeywell and Bendix Pacific, and 31 years at Westinghouse in design, simulation, and validation of navigation and tracking programs.

Farrell is the author of *Integrated Aircraft Navigation* (Academic Press, 1976; now in paperback after five hard-cover printings); *GNSS Aided Navigation & Tracking: Inertially Augmented Or Autonomous* (2009) – see JamesLFarrell.com – plus chapters in books edited by C.T. Leondes and by Cary Spitzer, and over 100 manuscripts (journal or conference papers, columns in *GPSWorld*, *InsideGNSS*, and *Washington Technology*). His section on satnav/inertial integration will appear in *Position Navigation & Timing technologies in the 21st Century*, co-edited by Brad Parkinson, to appear in 2020.

With VIGIL Inc., Farrell served as co-chairman of RTCA's GPS Integrity Working Group. During this time he continued teaching (at the university-, industry-, and conference-level) and consulting (for private industry, the U.S. Department of Defense, and university research programs).

Most recently, Farrell has focused his efforts on Global Positioning System/inertial integration research, calibration, and integrity – writing programs validated by in-flight data from Ohio University – and three-dimensional geometric morphometrics. However, his scope includes any and all modes of navigation integration (including visual/IMU, increasingly common in recent times).

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Abstract

Contemporary air traffic management (ATM) challenges are both (1) acute and (2) growing at rates far outpacing established ways for absorbing technological innovation. Lack of timely response will guarantee failure to meet demands. Immediately that creates a necessity to identify means of coping and judging new technologies based on possible speed of adoption. Part of the challenges are developments in capability, both recent and decades old. Some steps (e.g., Global Positioning System (GPS) backup) are well known and, in fact, should have progressed further long ago. Others (e.g., sharing raw measurements instead of position fixes) are equally well known and, if followed by further flight tests initiated (and successful) years ago, would have produced a wealth of in-flight experience by now if development had continued. Other possibilities (e.g., automated pilot override) are much less common and are considered largely experimental.

This SAE EDGE™ Research Report is aimed at focusing industry attention on unsettled ATM issues and activities that appear most likely to offer solutions, starting with the near term and continuing on toward increasing versatility and confidence as experience accumulates. In general, the more familiar developments tend to suggest quicker acceptance of test trial initiation, while comparatively unexplored techniques call for a more gradual assimilation. Flexibility for growth is needed in any event, without the pervasive delays that have obstructed progress for so long.

NOTE: SAE EDGE™ Research Reports are intended to identify and illuminate key issues in emerging, but still unsettled, technologies of interest to the mobility industry. The goal of SAE EDGE™ Research Reports is to stimulate discussion and work in the hope of promoting and speeding resolution of identified issues. SAE EDGE™ Research Reports are not intended to resolve the challenges they identify or close any topic to further scrutiny.

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