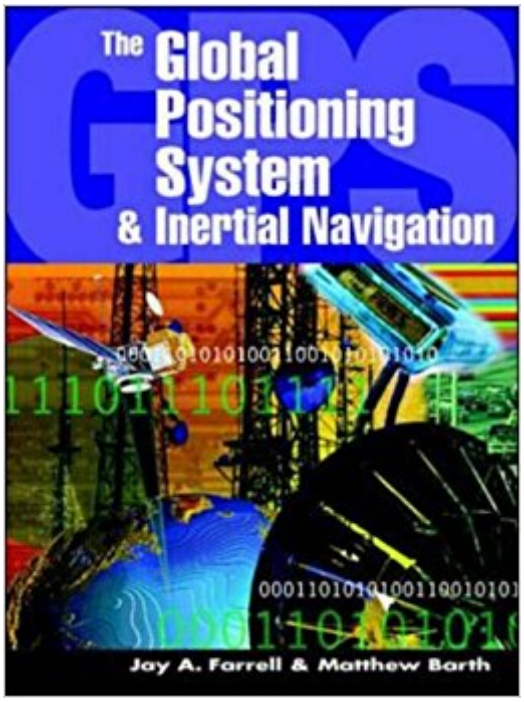
The Global Positioning System & Inertial Navigation



Synopsis

With GPS and INS hardware becoming ever smaller and less expensive, innovative opportunities for commercial navigation systems are everywhereÃƒâ ˆand continue to arise. Integrated GPS/INS systems have some real advantages, in terms of output rate, reliability, and accuracy. The Global Positioning System and Inertial Navigation is the first-ever reference to provide engineers and scientists with a detailed, top-to-bottom look at GPS and INS in a single volume. This in-depth text provides navigation system designers comprehensive and accurate coverage of such topics as coordinate frames and transformations, Kalman filtering techniques, navigation system performance analysis, GPS receiver ephemeris and pseudo-range processing, differential GPS, carrier phase processing, and attitude determination. Extensively cross-referenced to the literature on advanced navigation system design, this superb engineering reference is ideal for navigation systems designers, analysts, and project managers.

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Customer Reviews

With GPS and INS hardware becoming ever smaller and less expensive, innovative opportunities for commercial, military, and scientific navigation systems are everywhereÃƒâ ˆand continue to arise. Integrated GPS/INS systems have some real advantages, in terms of output rate, reliability, and accuracy. The Global Positioning System and Inertial Navigation is the first-ever reference to provide engineers and scientists with a detailed, top-to-bottom look at GPS and INS in a single volume. Features include: Integrated practical examples; In-depth case studies; Detailed theoretical

derivations; Guidelines for building integrated GPS/INS systems; Advanced GPS and INS techniques presented in a unifying format; Comparison of alternative implementation techniques; A systematic engineering design approach. This in-depth text provides navigation system designers comprehensive and accurate coverage of such topics as coordinate frames and transformations...Kalman filtering techniques...navigation system performance analysis...GPS receiver ephemeris and pseudo-range processing... differential GPS, carrier phase processing, and attitude determination. Extensively cross-referenced to the literature on advanced navigation system design, this superb engineering reference is ideal for navigation systems designers, analysts, and project managers.

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I thought that a time varying matrix diffeq, xdot = A(t)x, had an integrating factor iff the time-varying system matrix A(t) commuted with int(A(s): 0 -> t) for all t. Then the solution is x(t) = exp(int(A(s);0->t)x(0) For the rotation R, Omega clearly does not commute with its integral in this way. Is the closed form solution still valid? I don't know! It's obviously valid for small delta_t = t(k+1) - t(k), since then the relevant matrices are approximately constant.

First let me point out that the "error" mentioned by couple of reviewers are not errors. Perhaps the reviewers misunderstood or missed something.The NY reviewer wrote" dot{\bf}_(t) = - \Omega \bf_(t)whic is fine. but then it is concluded that\bf_(t) = exp(-\int_^t \Omega dt) \bf_(t_0)which is wrong because Ω is a function of time. "Actually this last line is in fact correct. I am not sure why reviewer think there is a problem. Perhaps the dummy integration variable t in the integral should have beendenoted by a different letter, but I think this is understood to be the dummy variable and not related to independent variable t. At any rate this equations is perfectly correct.Also the "errors" pointed out by reviewers with title "Mixed Results" are not errors.Matrix multiplication representation of the cross product has the right sign per convention that it is representing angular velocity of "a" frame relative to b frame.Multiplying this by -1, would represent angular velocity of b frame relative to "a" frame.The mappings from the quaternions to the Euler angles (Chapter 2 equations 2.47 through 2.49) are all correct. Perhaps the reviewer uses a different convention for the signs relative to reference and rotating frame.The book itself is probably one of the better books if one is not afraid of mathematical rigor (of course Mathematical rigor itself is relative). It does a

nice job of blending the inertial navigational with system theory and Kalman filtering methods.

I purchased this book mostly for its technical content and less for its descriptive narrative about inertial nav and GPS. My goal was to use the book as a basis for some analysis. Unfortunately, I can’t recommend the book to someone who can’t re-derive the equations in the book.One reviewer from New Mexico wrote: "There are some math errors [in Farrell & Barth’s book] that are obvious, but when trying to use a text as a reference I don’t think it’s my job to double check the author’s math!" But, lo! I think one NEEDS to check the math in this book because even the most trivial of computations can and do have errors in them. For example, one thing really irksome about the book is that the matrix representation for the cross product operation in Appendix A has an overall factor of (-1) buried in it -- and it’s wrong. Then the authors happily propagate this interesting "sign convention" throughout the book, meaning that you have to do a double take each time the book uses it. It’s a horrendous mess.The same NM reviewer also asked: "Can I trust this book as a reference?" I think it’s hit or miss. I spent over a week deriving and implementing the equations in Chapter 6. And even though I have some experience with coordinate frames and dynamics in rotating frames, it took a lot of effort to work through everything myself and correct the errors. Luckily most of the final equations are, indeed, correct in Chapter 6 -- save for a sign or two. On the other hand, I’m still trying to find the book’s sign errors in the mapping from the quaternions to the Euler angles (Chapter 2). Is there really an error? Or am I doing something stupid? With this book, I’ll have to figure it out for myself.This book has the potential to become an excellent reference and resource for inertial nav and/or GPS nav information. But as it stands, it’s a sketch of a book that leaves it up to the reader to wonder whether it’s him/her that’s missed the point, or the authors who mangled yet another equation.

I have struggled throught the first 2 chapters of this book and can’t believe how poorly written this is. Mathematical derivations suffer from "logic leaps" that are not at all intuitive. Coordinate frame definitions are adequate, but more figures are needed. The text references figures with Greek symbols. When you go to the figure the symbol is missing or changed to another symbol. There are some math errors that are obvious, but when trying to use a text as a reference I don’t think it’s my job to double check the author’s math! I contacted McGraw Hill about an errata sheet for the text. They don’t have one available, but said they would be glad to accept my inputs. Can I trust this book as a reference? I don’t know! I’m a complete novice in the field of Inertial Navigation and I don’t feel I’m qualified to "edit" their book for them. This is a poorly written book because it assumes the

audience is as well versed in Inertial Navigation and GPS as the author. One final gripe is that Mathematical Notation is referenced in Appendix A of the text. When trying to read the body of text, you must constantly refer to this appendix to try and figure out what the author is trying to convey. It’s not bad, but it makes reading tiring and slow! The appendix is fine, but the introductory chapters in a well written text normally introduce the reader to the notation gradually, explaining symbols and conventions. Later chapters can then use less and less explanatory text for notation. This book could really be a "home-run" with some good editing and a second printing.

I am an electrical engineer and was looking for an insight into INS. From what I had read, I had the impression that this book would be at a level I could understand with relative ease - not the case. I have now purchased an alternative.This is what happens when you only have a limited review capability before purchasing.