Technical Comments

Comment on "Improved Method for Solving the Algebraic Riccati Equation"

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THE purpose of this correspondence is to alert the readers of the Note by Holley and Wei[1] to a paper of Laub.[2] Laub's paper contains all of the results presented by Holley and Wei, and in addition develops a discrete time version of the Schur method, provides operation counts and a discussion of numerical stability and conditioning, as well as a number of examples including one of 64th order.

References

[1] Holley, W. E. and Wei, S. Y., "Improved Method for Solving the Algebraic Riccati Equation," *Journal of Guidance and Control,* Vol. 3, March-April, 1980, pp. 190-192.
[2] Laub, A. J., "A Schur Method for Solving Algebraic Riccati Equations," *IEEE Transactions on Automatic Control,* Vol. AC-24, Dec. 1979, pp. 913-921.

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Reply by Author to N.R. Sandell Jr.

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S.Y. WEI and I wish to thank N. R. Sandell for pointing out Laub's interesting paper[1] to the readers of the *Journal of Guidance and Control.* At the time the original manuscript for our paper[2] was prepared, Laub's work was not yet available and was unknown to us. We apologize for any confusion that may have resulted from the delays in publication of our results. While we believe that his and our development occurred essentially in parallel, we acknowledge the definite priority of his publication.

The methods proposed in Laub's and our paper are similar except for details in the technique for obtaining the ordered quasitriangular (Schur) decomposition. We prefer to compute the ordered decomposition directly from the original Hamiltonian matrix with previously computed eigenvalues, rather than by using the reordering scheme employed by Stewart[3] in the HQR3 program used by Laub. Our procedure usually results in fewer orthogonal similarity transformations being performed, thus improving the numerical stability and roundoff error properties of the algorithm. A discussion of the operation counts and a quantification of the roundoff properties of our method are given in S. Y. Wei's doctoral thesis[4] to appear June, 1981. Any interested reader who wishes copies of the FORTRAN program and a detailed users manual may write for information.

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References

[1] Laub, A.J., "A Schur Method for Solving Algebraic Riccati Equations," *IEEE Transactions on Automatic Control,* Vol. AC-24, Dec. 1979, pp. 913-921.
[2] Holley, W.E. and Wei, S.Y., "Improved Method for Solving the Algebraic Riccati Equation," *Journal of Guidance and Control,* Vol. 3, March-April 1980, pp. 190-192.
[3] Stewart, G.W., "HQR3 and EXCHNG: Fortran Subroutines for Calculating and Ordering the Eigenvalues of a Real Upper Hessenberg Matrix," *ACM Transactions on Mathematics and Software,* No. 2, 1976, pp. 275-280.
[4] Wei, S.Y., "Application of Linear Quadratic Control in Reduction of Aerodynamic Forces on Aircraft," Ph.D. Dissertation, Dept. of Mechanical Engineering, Oregon State University, June, 1981.

Errata

Controllability and Observability for Flexible Spacecraft

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REFERENCES 12, 13, and 14 were inadvertently omitted from the list of references at the end of this article. They are as follows:

[12] Hughes, P.C. and Skelton, R.E., "Controllability and Observability for Flexible Spacecraft," *Proceedings of the 2nd VPI&SU/AIAA Symposium on Dynamics and Control of Large Flexible Spacecraft,* Blacksburg, Va., June 1979.
[13] Hablani, H.B. and Skelton, R.E., "Generic Model of a Large Flexible Space Structure for Control Concept Evaluation," accepted for presentation at the AIAA 19th Aerospace Sciences Meeting.
[14] Skelton, R.E., "Model Truncation Using Controllability, Observability Measures," in *Dynamics of Multibody Systems,* Springer-Verlag, 1978.

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