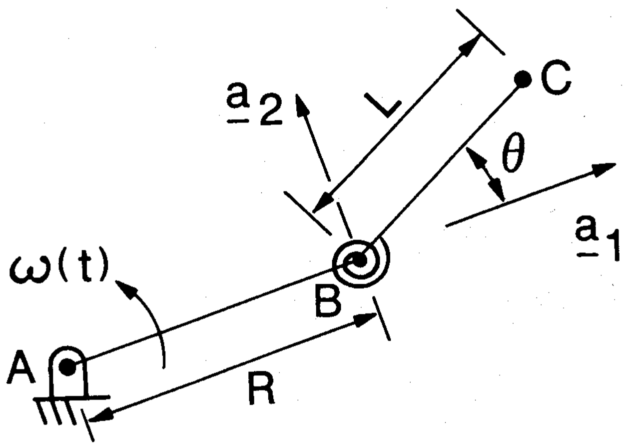

Fig. 1 Simple system undergoing small elastic motion in a rotating reference frame.

Kane's (linearized) equations of motion:

$$m\tilde{a}\cdot\tilde{v}^P_{\dot{\theta}}+k\theta=0 \tag{5}$$

where all nonlinear terms arising in the dot-product are ignored.

Gibbs-Appell method:

Nonlinear acceleration:

$$\begin{aligned} a^P = a_1[& -(\dot{\omega}+\ddot{\theta})L\sin\theta-(\omega+\dot{\theta})L\dot{\theta}\cos\theta \\ & -\omega^2R-\omega(\omega+\dot{\theta})L\cos\theta]+a_2[\dot{\omega}R+(\dot{\omega}+\ddot{\theta})L\cos\theta \\ & -(\omega+\dot{\theta})\dot{\theta}L\sin\theta-\omega(\omega+\dot{\theta})L\sin\theta] \end{aligned} \tag{6}$$

yields

$$\frac{\partial a^P}{\partial\ddot{\theta}}=-L\sin\theta a_1+L\cos\theta a_2 \tag{7}$$

Gibbs-Appell equation

$$\frac{\partial}{\partial\ddot{\theta}}[\tfrac{1}{2}ma^P\cdot a^P]+k\theta=0 \tag{8}$$

after implicit differentiation becomes

$$m\tilde{a}^P\cdot\frac{\partial\tilde{a}^P}{\partial\ddot{\theta}}+k\theta=0 \tag{9}$$

where all nonlinear terms arising in the dot-product are ignored. Now Eq. (9) is, of course, identical to Kane's equation, provided $\partial a^P/\partial\ddot{\theta}$ is linearized from Eq. (7), which requires that Eq. (6) be kept fully nonlinear in θ as is done here. This is precisely the point: to get correctly linearized equations via the Gibbs-Appell method, one must retain all nonlinearities up to the expression for acceleration—a cumbersome task not required in Kane's method, where one needs to retain nonlinearities only up to the velocity level. The additional labor involved with the Gibbs-Appell method over Kane's method can be so enormous with more complicated problems, such as in Ref. 2, as to make the analysis extremely unwieldly.

References

[1]Desloge, E. A., "Relationship Between Kane's Equations and the Gibbs-Appell Equations," *Journal of Guidance, Control, and Dynamics*, Vol. 10, No. 1, Jan.-Feb. 1987, pp. 120-122.

[2]Kane, T. R., Ryan, R. R., and Banerjee, A. K., "Dynamics of a Cantilever Beam Attached to a Moving Base," *Journal of Guidance, Control, and Dynamics*, Vol. 10, No. 2, March-April 1987, pp. 139-151.

Book Announcements

LEONDES, C.T., Editor, University of California at Los Angeles, ***Control and Dynamic Systems, Volume 24: Decentralized/Distributed Systems,*** Academic Press, New York, 1986, 362 pages, $57.50.

Purpose: This is the third in a series of three volumes on the subject of advances in techniques for the analysis and synthesis of decentralized or distributed control and dynamic systems.

Contents: A two-level parameter estimation algorithm for large-scale systems (M.P. Spathopoulis). Suboptimality bounds on decentralized control and estimation of large-scale discrete-time systems (M. Sinai). Decentralized control using observers (B. Shahian). System zeros in the decentralized control of large-scale systems (T.A. Kennedy). Direct model reference adaptive control for a class of MIMO systems (K.M. Sobel and H. Kaufman). Passive adaptation in control system design (D.D. Sworder and D.S. Chou). Index.

LEONDES, C.T., Editor, University of California at Los Angeles, ***Control and Dynamic Systems, Volume 25: System Identification and Adaptive Control,*** Academic Press, New York, 1987, 361 pages.

Purpose: This is the first in a series of three volumes devoted to the subjects of system parameter identification and adaptive control. The book is intended as a reference.

Contents: Uncertainty management techniques in adaptive control (H.V. Panossian). Multicriteria optimization in adaptive and stochastic control (N.T. Koussoulas). Instrumental variable methods for ARMA models (P. Stoica, B. Friedlander, T. Soderstrom). Continuous and discrete adaptive control (G.C. Goodwin, R. Middleton). Adaptive control: a simplified approach (I. Bar-Kana). Discrete averaging principles and robust adaptive identification (R.R. Bitmead, C.R. Johnson, Jr.). Techniques for adaptive state estimation through the utilization of robust smoothing (F.D. Groutage, R.G. Jacquot, R.L. Kirlin). Coordinate selection issues in the order reduction of linear systems (A.D. Doran).

ROBERTS, R.A., and **MULLIS, C.T.,** University of Colorado at Boulder, ***Digital Signal Processing,*** Addison-Wesley, New York, 1987, 578 pages.

Purpose: This text is used for a two-semester sequence on digital signal processing. The prerequisites for this material are a course in linear system theory including both discrete-time and continuous-time systems and some background in probability theory and random processes.

Contents: Digital signal processing. Discrete-time signals and systems. The z-transform. Fourier analysis of discrete-time signals and systems. Fast algorithms for the discrete Fourier transform. The approximation problem for digital filters. Least-squares filter design. Internal descriptions for digital filters. Finite length register effects in fixed point digital filters. Digital processing structures. Spectral estimation. Appendices. References. Suggested readings. Index.