Technical Comments

Comments on "Structural Optimization in the Dynamics Response Regime: A Computational Approach"

R. A. Ridha*
Bendix Corporation, South Bend, Ind.

IN Ref. 1 the authors use the method of feasible directions in the optimization part of their paper. Although the usable feasible direction is correctly defined in their Eqs. (27) and (28), their method of obtaining the optimum feasible direction is not optimum.

In order to find an optimum feasible vector the authors of Ref. 1 solve a linear programming problem in each interaction. This approach is too long and expensive for practical applications. Recently[2] a simpler and more direct method has been developed for finding the optimum feasible direction. This method involves operations on vectors by sweeping out of the direction vector the components which lead to violation of the active constraints.

Furthermore, the method presented in Ref. 2, and overlooked in Ref. 1, leads to a faster convergence towards the optimum and avoids certain local optimums. A generally "steeper" direction vector is used because only the effective-active constraints are included in the sweeping process.

If the component of the direction vector along the gradient of an active constraint is positive, the movement in that direction will not lead to a violation of the active constraint. Disregarding such active constraints results in the steepest feasible direction, i.e., the direction vector closest to the gradient of the objective function.

In conclusion, incorporating the approach presented in Ref. 2 for finding the optimum feasible direction will lead to an improved optimization technique, and further the contribution of Ref. 1.

References

[1] Fox, R. L. and Kapoor, M. P., "Structural Optimization in the Dynamics Response Regime: A Computational Approach," *AIAA Journal*, Vol. 8, No. 10, Oct. 1970, pp. 1798–1804.

[2] Ridha, R. A. and Wright, R. N. "Minimum Cost Design of Frames," *Journal of the Structural Division*, ASCE, Vol. 93, No. ST4, Paper 5394, Aug. 1967, pp. 165–183.

Received January 20, 1971.

* Project Engineer, Analytical Mechanics Department, Energy Controls Division.

Reply by Author to R. A. Ridha

R. L. Fox*
Case Western Reserve University, Cleveland, Ohio

RIDHA has overlooked several points in his comment. To begin with, the issue of efficiency of the direction finding solution itself is academic because the linear program which is solved at each iteration of Zontendijk's method of feasible directions is a mere pip of calculation when compared with the other arithmetic involved in solving a "practical" problem. A second, and perhaps more important point, is the fact that the "new" method described by Ridha and Wright is exactly Rosens gradient projection method. This method was first described in Ref. 1 although the discussion and comment in Sec. 4.3 of Ref. 2 may be helpful. The method was also used to solve the problem in Ref. 3. Although it is somewhat obscured by the form of the calculation, Ridha and Wright do a Gauss elimination process to perform the projection.

Rosens method is indeed a superb technique but its main usefulness is limited to problems with linear constraints. For problems with convex constraint surfaces (as are typical in many applications) the direction produced by it is infeasible and the additional costly step to get back into the feasible domain as described by Ridha and Wright is necessary. Incidentally, with the "pushoff factors" in the method of feasible directions set to zero, the method produces the projected gradient vector and it is therefore a sub-method of the feasible direction method. In conclusion, the method was not "overlooked" but disregarded as inappropriate for this class of problems.

References

1. Rosen, J. B., "The Gradient Projection Method for Nonlinear Programming, Part 1," *Journal of the Society for Industrial and Applied Mathematics*, Vol. 8, No. 1, March 1960, pp. 181–217.
2. Fox, R. L., "Optimization Methods for Engineering Design," Addison-Wesley, Reading, Mass., 1971, pp. 196–205.
3. Brown, D. M. and Ang, A. H. S., "Structural Optimization by Nonlinear Programming," *Journal of the Structural Division, Proceedings of the American Society of Civil Engineers*, Vol. 92, No. ST6, Oct. 1966, pp. 319–340.

* Associate Professor of Engineering. Member AIAA.
Received March 15, 1971; revision received April 20, 1971.

Comment on "Stability of a Spinning Body Containing Elastic Parts via Liapunov's Direct Method"

Valentin V. Rumyantsev*
Computing Center of the USSR Academy of Sciences, Moscow, USSR

IN his paper[1] L. Meirovitch has solved the problem on the stability of a spinning body containing elastic parts. He has obtained the system of the differential equations by means of Hamilton's principle. The motion of the system is described by a "hybrid" set of ordinary differential equations and partial differential equations. Considering the Hamiltonian as a Liapunov function and functional simultaneously the author has obtained the sufficient conditions of the stability.

The author asserts, that he has presented "a new method of approach to the stability problem of hybrid systems . . . The method consists of an extension of the Liapunov direct method by considering for testing purposes a hybrid form, that is a form which is a Liapunov function and functional

Received March 12, 1971.

* Professor.