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# Design of an Optimum Tuned Mass Damper for Cantilever Beam Response Reduction

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**Abstract:** The optimal design of a tuned mass damper (TMD) in the frequency domain is investigated in this paper to reduce the dynamic response of a cantilever beam. The random vibration theory is used to determine the mean square acceleration of the cantilever beam's end point as the objective function to be reduced. Furthermore, a Differential Evolution (DE) optimization approach is used to estimate the ideal TMD coefficient of mass, stiffness, and damping. These parameters' upper and lower limit values are considered. Most of the past research has focused on determining TMD stiffness and damping characteristics. This study does, however, include optimization of TMD mass parameters to calculate the mass quantity. Furthermore, the DE method, a stochastic optimization algorithm, is underutilized for optimizing TMD parameters. As a result, this approach is utilized on the goal function to find optimal TMD settings. Following this optimization, tests are carried out on the cantilever beam with TMD system, using harmonic base excitations that resonant the beam's foremost modes and white noise excitation. In terms of optimum TMD design, the proposed method is extremely practical and successful. The response of a cantilever beam under dynamic interactions is significantly reduced when a TMD is constructed properly.

**Keywords:** cantilever beam, vibration control, tuned mass damper, transfer function, differential evolution

## References

[1] AYDIN E., DUTKIEWICZ M., ÖZTÜRK B., SONMEZ M. OPTIMIZATION OF ELASTIC SPRING SUPPORTS FOR CANTILEVER BEAMS. STRUCT MULTIDISC OPTIM 62, 55–81 2020. HTTPS://DOI.ORG/10.1007/S00158-019-02469-3.

[2] PRZEMIENIECKI J.S., THEORY OF MATRIX STRUCTURAL ANALYSIS, MCGRAW-HILL, NEW YORK, 1968.

[3] TAKEWAKI I., “OPTIMAL DAMPER POSITIONING IN BEAMS FOR MINIMUM DYNAMIC COMPLIANCE”, COMPUT. METHOD. APPL. MECH. ENG., 156, 363-373, 1998.

[4] SON J.H. AND KWAK B.M., “OPTIMIZATION OF BOUNDARY CONDITIONS FOR MAXIMUM FUNDA-MENTAL FREQUENCY OF VIBRATING STRUCTURES”, AIAA J., 31(12), 2351-2357, 1993