The Shape of the Optimal Javelin YOSSI FARJOUN, MIT, JOHN NEU, UC Berkeley — To find the shape of a javelin whose vibrations dampen the fastest, we seek to maximize the eigenvalue of the first eigen-mode of a vibrating rod. The problem is related to (and is inspired by) the classical problems of finding the tallest and strongest columns solved by J. B. Keller [1], and J. B. Keller and F. I. Niordson [2]. A 4th order ODE for the maximizing eigen-mode is readily found, however it is ill-conditioned at the boundaries, and standard numerical methods fails. Using a similarity solution, we "peel away" the singularity, and solve the remaining part "backwards". The resulting shape has a frequency of vibration 5 times larger than that of the uniform-diameter rod. The method of solution is applicable to other similar problems. For example, we confirm the shape of the tallest column with it.

[1] The Strongest Column / J. B. Keller ; Arch. Rat. Mech. Anal. 1960 **(5)**, pp. 275–285
[2] The Tallest Column / J. B. Keller and F. I. Niordson ; J. Math. Mech. 1966 **(16)**, pp. 433–446

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