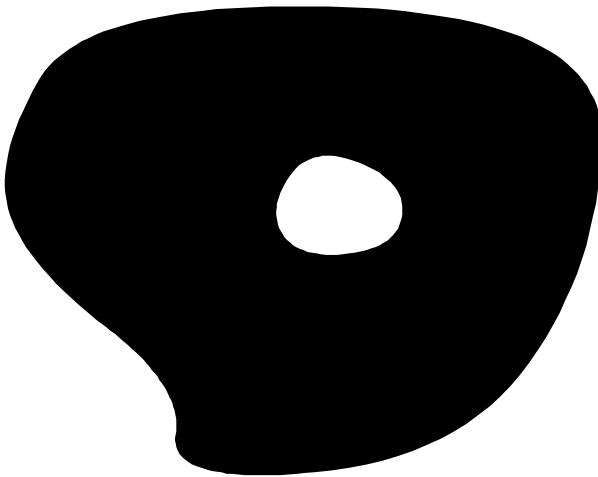


Homework #4

ME 501 Winter 2000

Due Day is April 10, 2000

1. A black-white image is given as follows. From this image, obtain a CAD model that is represented by a combination of linear straight lines and arcs as well as circles by using the least squares method, MATLAB or MATHEMATICA, and any Image Processing Software such as NIH Image (its Window version may be obtained from Scion Science Corporation : http://www.scioncorp.com/frames/fr_scion_products.htm as a free software for its beta version).

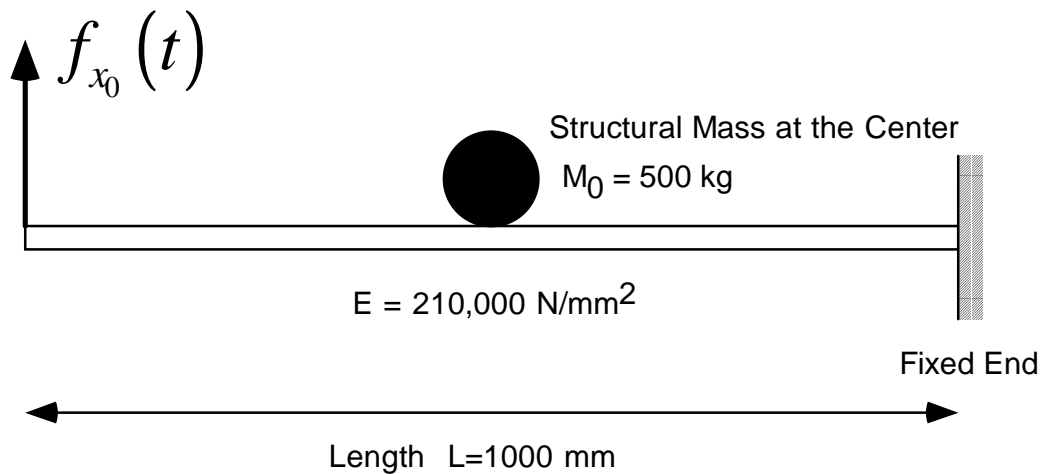


2. Consider a box beam that is supported by the fixed end at $L = 1000$ mm as shown in the following. Suppose that a non-structural mass $m_0 = 500$ kg is applied at the center of the beam, and assume that Young's modulus is $E = 210,000$ N/mm², the hollow rectangular cross section of the beam is made of 1 mm thick plate with height 100 mm and width 50 mm. Design the external applied force $f_{x0}(t)$ at the free end $x = 0$ of the beam so as to minimize the L2 norm of the displacement at the center of the beam where the non-structural mass is applied during the time period $(0, T)$, $T = 3$ min, when the initial displacement $u_0(x)$ is zero all over the beam and the initial velocity is assumed by a

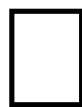
piecewise linear function $v_0(x) = \begin{cases} -10,000 \text{ mm/sec} & , x \in (0, 500) \\ 20(x-1000) \text{ mm/sec} & , x \in (500, 1000) \end{cases}$. You may use

the finite element method, finite difference method, or analytical method to solve beam vibration problem, and MATLAB or MATHEMATICA to find the optimal control force $f_{x0}(t)$.

Designed Force at Free End



Beam Cross Section



Box Beam
thickness 1 mm
height 100 mm
width 50 mm

Additional Information

If you have questions about OPTIMIZATION, you may look at the Web site:

<http://www-unix.mcs.anl.gov/otc/Guide/faq/>
Optimization Frequently Asked Questions

I believe you will enjoy.