COMPUTATIONAL INVERSE TECHNOLOGIES FOR MATERIAL CHARACTERIZATION OF FGMS

Codes Developed

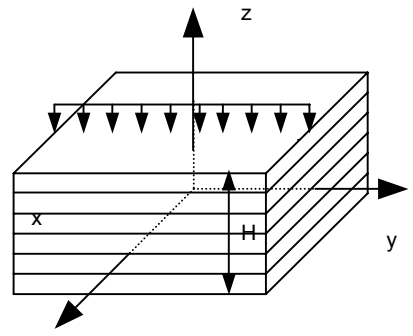
- **TRANSFGM Transient wave** analysis of FGM plate
- MGAFGM: Material characterization of FGM using modified Genetic Algorithm

Application

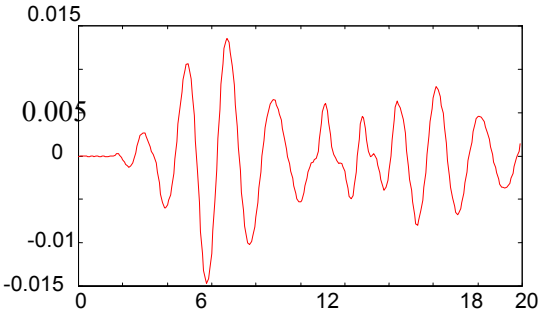
Non-destructive evaluation (NDE) of material property of functionally graded material plate

Material Characterization

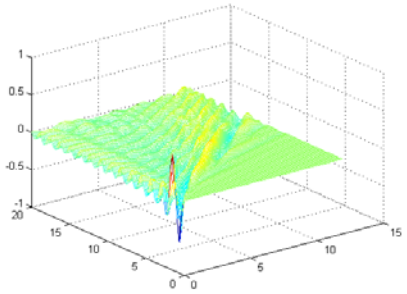
Effective use of FGM relies on a precise knowledge of the material property of the constituent materials; hence their property evaluation has been one of the focuses of research. A **computational inverse technique** is presented for characterizing the material property of Functionally Graded Material (FGM) plates, using the dynamic displacement response on the surface of the plate as input data. A **modified hybrid numerical method** is used as the forward solver to calculate the dynamic displacement response on the surface of the plate for given material property varying continuously in the thickness direction. A **uniform crossover micro-genetic algorithm (uniform μGA)** is employed as the inverse operator to determine the distribution of the material property in the thickness direction of the FGM plate. Examples are presented to demonstrate this inverse technique for material characterization of FGM plates.



FGM plate subjected to a line load



The time history of vertical displacement



Displacement in the x-t plane

Table 1 Uniform μGA search space for the material characterization of FGM plate

Original data	Search Range	Possibilities #	Binary digit
0.973	0.681-1.000	256	8
0.875	0.613-1.000	256	8
0.657	0.456-0.854	256	8
0.488	0.342-0.634	128	7
0.271	0.100-0.352	128	7

Table 2 Characterized result of volume fractions for FGM plate

Volume fractions	Results (deviation) for different noise levels free	2%	5%	10%
0.973	0.967(-0.6%)	0.974(0.1%)	0.976(0.3%)	0.976(0.3%)
0.875	0.860(-1.7%)	0.866(-1.0%)	0.852(-2.6%)	0.863(-1.4%)
0.657	0.656(-0.01%)	0.671(2.1%)	0.685(4.3%)	0.676(2.9%)
0.488	0.488(0%)	0.502(2.9%)	0.507(3.9%)	0.500(2.4%)
0.271	0.276(2.0%)	0.259(-4.3%)	0.260(-4.2%)	0.253(-8.6%)