AMAT software

The AMAT is destined for the calculation of the contribution tensors of elastic properties of an individual elastic inhomogeneity in an infinite elastic medium (matrix). The software makes use of the Gaussian Approximation (GA) mesh free numerical method [1,2]. The calculation is realized on a uniform node grid.

Instructions for use

1. To open the software please run **Directory of installation**\dist\soft_AMAT_V3\soft_AMAT_V3.exe
2. Enter the Young modulus and the Poisson ratio of the matrix and the inhomogeneity into the corresponding fields.
   IMPORTANT NOTE: Current version does not support anisotropy. Only the fields 'E1' and 'v12' are active.

3. A. 3D functions and STL files (pores and solid inclusions)

   Enter the function that describes the shape of the inhomogeneity in the following form: $F(x,y,z)=0$.

   FORTRAN notation (**) must be used for exponentiation. For example, the expression for the ellipsoid will look like: $(x/a)**2+(y/b)**2+(z/c)**2-1$, where $a,b,c\le 1$. The function for supersphere will look like: $abs(x)**p+abs(y)**p+abs(z)**p-1$
   The field supports the following functions: sin, cos, tan, arcsin, arccos, arctan, sinh, cosh, tanh, arcsinh, arccosh, arctanh, exp, log, log10, log2, absolute, sqrt, cbrt, sign.
   For more details please see
   https://docs.scipy.org/doc/numpy-1.13.0/reference/routines.math.html.
   OR

   Import a valid .stl file.

   B. 2D functions and STL files (crack)

   Enter the function that describes the shape of the inhomogeneity in the following form: $F(x,y)=0$.

   <u>No translation of planes:</u>

   $x+y+z+1$ – wrong

   $x+y+z$ – right

If you need to supply only two variables drop z:

$y + z$ – wrong

$x + y$ – right

OR

Import a valid .stl file (must check “crack” box (!)).

IMPORTANT NOTE: The inhomogeneity function must be normalized to its longest dimension, i.e., no dimension must exceed $[-1,1]$ range.

4. Adjust the number of discretization intervals. This number defines the density of the node grid. Larger number corresponds to a finer node grid; generally a finer node grid gives more precise results, but the calculation time is longer.

5. It is possible to observe the shape of the inhomogeneity and the resulting node grid by clicking on the ‘Show geometry’ button.

6. Adjust the convergence tolerance. The number defines how accurate will be simulations; numbers smaller than 0.001 may result in very long calculations.

7. In order to start the calculations click on the ‘Start’ button.
   The resulting tensors of compliance and stiffness contribution of the considered inhomogeneity will be given in two new output windows.
   NOTE: The contribution tensors will be given in Voigt notation, here the indices 44 correspond to indices 2323, 55 to 1313, and 66 to 1212.

8. (Optional) It is possible to save the calculation results as a .txt file by selecting ‘Save as’ option in ‘Home’ menu.

IMPORTANT: The software is in early alpha stage. Calculation-breaking bugs and errors are expected. All feedback would be appreciated.

[1] Kanaun, S., & Pervago, E. (2011). Combining self-consistent and numerical methods for the calculation of elastic fields and effective properties of 3D-matrix composites with periodic and random microstructures. International Journal of Engineering Science, 49 (5), 420–442.

[2] Kanaun, S., (2009). Fast solution of the elasticity problem for a planar crack of arbitrary shape in 3D-anisotropic medium. International Journal of Engineering Science, 47(2), 284-293.