Version 1.0

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1 Introduction

Nocal is python-based nonlocal pre/post processing software for nonlocal analysis of finite element analysis results.

2 Input Deck

Nocal is controlled by a python dictionary where all the user inputs (i.e., *cards*) are stored. This file must be called dictionary.py . Each subsection describes a different card and the data type of each input is shown in italics next to the card

2.1 deckName

String
If the user chooses to build the connectivity matrix from an Abaqus input deck, this is the name of the deck minus the .inp.
Example:
For an abaqus input deck named paraFipMesh_11.inp
`'deckName' :' paraFipMesh_11'`
Module Location

- createAllNlElsetsInRegionParaNConf.py,
- getElemCent.py,
- nonlocalFIP.py,
- nonlocalFIPWeight.py

2.2 dx

Float
The is the length of an edge of square nonlocal volume, for spherical nonconformal volumes Nocal will convert this value into a sphere with an equivalent volume to the cube with edges dx
Example:
For $\Delta x = 0.215443469$
`'dx' : 0.215443469` Module Location

- createAllNlElsetsInRegionParaNConf.py,

2.3 numProc

Integer
Number of processors to use when preprocessing nonlocal volumes
Example:
If you wanted to use 4 processors

'numProc' : 4 Module Location

- createAllNlElsetsInRegionParaNConf.py,

2.4 isWeight

boolean
True if you want a weighted average over the nonlocal volume; False if you want a standard mean
The weighted average for a value Γ is given by

$$\Gamma^{\mathrm{nl}}(\boldsymbol{x}) = \frac{1}{A(\boldsymbol{x})} \int_{\Omega} \phi(\boldsymbol{x} - \boldsymbol{y}) \Gamma^{\mathrm{loc}}(\boldsymbol{y}) d\Omega, \tag{1}$$

where Γ^{loc} and Γ^{nl} are the local and nonlocal values of some finite element output Γ respectively. The position where the nonlocal Γ is calculated is $\boldsymbol{x}$ and $\boldsymbol{y}$ is positions around $\boldsymbol{x}$ over which Γ^{loc} is integrated. The nonlocal volume is Ω, and ϕ is a Gaussian distributed weighting function. The normalizing value of A is given by

$$A(\boldsymbol{x}) = \int_{\Omega} \phi(\boldsymbol{x} - \boldsymbol{y}) d\Omega, \tag{2}$$

and

$$\phi(\boldsymbol{x}) = \exp\left(-||\boldsymbol{x}||^2 / l^2\right), \tag{3}$$

where l is the nonlocal length scale.
Example:
if you want a weighted average
'isWeight' : True Module Location

- runNonlocalFip.py

2.5 resultsFileName

String
This is the name of the results file where you want to postprocess over the predetermined nonlocal values, you should include the extention (although what extension it is does not matter)
Example:
For a results file named paraFipMesh-FIP_1_11.txt
'resultsFileName' :' paraFipMesh − FIP_1_11.txt'
Module Location

- nonlocalFIP.py,
- nonlocalFIPWeight.py

2.6 L

Float
Length scale l for Equation 3, It is only used if isWeight=True
Example:
You want to weight over a region of $l = 0.13365046175$ `'L' : 0.13365046175`
Module Location

- nonlocalFIPWeight.py

3 Running Nocal

If all finite element input decks and all results files are in ./data (or .\data) then run from your command line
`python mainfunctiongithub.py`
The results of any postprocessing are stored in ./results (or .\results)