v12001-04-09parskip-2001-04-09.sty v22018-08-24

mGRF Documentation

Release V0.1

Manoj

Nov 26, 2019

CONTENTS:

CHAPTER

ONE

ALPHABETICAL LIST OF FUNCTIONS AND SCRIPTS WITH DESCRIPTION

contourDomainPlot (*fem*, *domainID*, *userData*, *colourBar*, *varargin*)

A helper fucntion to create contourplot of a given mesh (domain) within fem structure of VRM for data specified by the user.

Parameters

- **fem** – fem structure from VRM after loading the mesh
- **domainID** – Domain ID of the current mesh file in the fem structure
- **userdata** – vector of values to visualise, length = nNode X 1
- **colourBar** – 0 or 1, creates a colourBar when = 1
- **vargin** – typically ax, axis to plot the figure, if empty a new axis is created

Returns: The coutourplot of the mesh with user given values ar mesh nodes

getAssembledKe (*fem*, *domainID*)

A function to assemble the stiffness matrix of a given mesh element=element strucutre

Parameters

- **fem** – fem structure from VRM after loading the mesh
- **domainID** – Domain ID of the current mesh file in the fem structure

Returns Ke the assemble stiffness matrix

getElementStifness (*fem*, *eleId*)

Helper function for *getAssembledKe()*

getMgrfDev (*mGRF*, *meshCoord*, *keyPointsID*, *meshStiffMat*, *nSample*)

The main function to simulate non-ideal parts using morphing-Gaussian Random Fields(mGRF). All options to the generation of non-ideal parts are to be provided in the mGRF structure. The mGRF structure has to main inputs:

1. mGRF.HypParmOpt.Type - corresponding to the different ways to input the hyper-parameters of the Gaussian Random Field
2. mGRF.NIdev.Type - corresponding to the type of non-ideal deviatons to be slimulated

Parameters

- **meshCoord** – coordinates of all mesh nodes an nNodes X 3 matrix
- **keyPointsID** – node ID of all the key points
- **meshStiffMat** – The stiffness matrix for the whole mesh
- **nSample** – Number of non-ideal part instances to be simulated
- **mGRF.HypParmOpt.Type** – 'measData' | 'manual' | 'load'
- **Options_specific_to'measData'** –

- **mGRF.HypParmOpt.devPatterns** – nInstances x nNodes matrix of non-ideal deviations
- **Options_specific_to'manual'** –
- **mGRF.HypParmOpt.sn** – noise standard dev
- **mGRF.HypParmOpt.lScale** – characteristic length scale, 3X1 vector for x,yand z directions
- **mGRF.HypParmOpt.sf** – scaling factor (set to 1 by default)
- **Options_specific_to'file'** –
- **mGRF.HypParmOpt.File** – name of the .mat file containing optimised hyper parameter values for a batch of deviations%
- **mGRF.NIdev.Type** – 'dent'|'flange'|'bending'|'formErr', String defining the type of non-ideal deformatios
- **mGRF.NIdev.Probability** – confidence value that max form error is less than specified value (between 0-1)
- **mGRF.NIdev.MaxFormError** – Maximum specified form error
- **mGRF.NIdev.NBasis** – Number of basis to use for interpolating the covariance matric for whole mesh
- **Options_specific_to'bending'** –
- **mGRF.NIdev.Bending.ID** – Vector of length 2 representing two nodes forming the bending axis
- **mGRF.NIdev.Bending.Theta** – Bending angleabout the axis in degrees
- **Options_specific_to'dent'|'flange'_local_deformations** –
- **mGRF.NIdev.Local.ID** – vector containing node IDs of all nodes being manipulated
- **mGRF.NIdev.Local.Dev** – nID X 1, vector of local deformation of key points

Returns dev - The nNodes X nSamples matrix of non-ideal part deviations

---

Note: The function depends on gp Toolbox and should be in the matlab path before the *getMgrfDev()* is called.

---

mGRF_main

A script demonstrating the abilites of non-ideal part modelling and simulation using the mGRF methodology It shows the modelling and simulation of non-ideal parts of an automotive door inner for:

1. Local deformation of flange.
2. Global deformation of bending.

It also demonstrated various options to find the optimum covariance function parameters (hyper-parameters), namely:

1. Learn from cloud of point data
2. Load parameters from a file.
3. Set the parameters manually.
4. Use a default set of parameters.

setCovStruct(*type*, *varargin*)

A function to help set options of the mean and covariance fuction according to gp toolbox. Matern covariance function is used as defalult throughout

Parameters

- **type** – 'default'|'user' string
- **If_type_is'user'_three_vectors_are_expected** –
- **sn** – 1x1 scalar, noise standard dev (makes surface points pass through key points if zero). Default is 0.001
- **lscale** – 3x1 characteristic length scale in x, y and z respectively, default is 20, 20, 10 mm
- **sf** – 1x1 scalar, latent function standard dev or output scaling factor, Default is 1

Returns Covariance function parameters in syntax compatible with gp toolbox