**FE Fitting for Dense data from LiuYi’s Code**

The main program: Main\_FitDisplacement.f

**Step 1: Call readGeometry**

*Input files:*

*(a): nodalCenter.dat*

*(b): prolateParameters.dat*

*(c): transform.dat*

**Step 2: Call readFittingWeight** (refer to equation 2.4 in DisplacementFiitinguvw2.doc,  etc)

*Input files: FitWeight.dat*

**Step 3: Call readDENSEData**

**Step 4: Call readMesh4Deformation**

**Call readMesh4StrainField**

**Call readMesh4VectorField**

*The subroutines are defined in ReadFEMeshs.f, there are 3 different mesh densities, and ready for tecplot output.*

**Step 5:** read layer mesh information and volume calculation

**Call GetBasicGroupMeshInform(NLayer,MaxG)**

**Call GetLayerpartition**

**Call GetDetailGroupMeshInformation**

**Call SetGaussVolumeIntegration**

**Call ReadLayerMesh**

**Step 6: Call open\_ALL\_OutPutFiles**: define all output files

**Call PlotInitialMeshNPoints**

**Step 7:** assign the initial dense data to uGuide, vGuide, wGuide, and weightGP, GP stands for guide points

*NGPoint=NDPoint*

*Do i=1, NGPoint*

*uGuide(i)=uvw0DENSE(1,i)*

*vGuide(i)=uvw0DENSE(2,i)*

*wGuide(i)=uvw0DENSE(3,i)*

*weightGP(i)=WeightDENSE(i)*

*enddo*

**Step 8 : Call FittingErrParameters** (defined in FittingFunctions.f, refer to DisplacementFiitinguvw2.doc, equation 1.3)

*In the code, the name the parameters generally are the same as in equation 1.3.  is referred to PGuide points*

**Step 9**: **Call RegFunctions** (defined in Regularizations.f, refer to DisplacementFiitinguvw2.doc, equation 2.4)

NF=0 (line 181) : NF is the state variable for matrix [decomposition, which only need to be called once in the running. If NF==0, need decomposition; otherwise, no need.](http://en.wikipedia.org/wiki/QR_decomposition)

**Step 10**: a loop from phase 1 to the last phase for fitting

**Do 8000** phase

**Do 9000** Degree of Freedom

pGuide(n) = disuvwDENSE (Jdis, n, IP)

displacement DOF No. of points phase

**Call Fitting\_brr\_N\_S0** : (*in 'FittingFunctions.f', refer to DisplacementFiitinguvw2.doc, equation 1.3)*

**Call TotalMatrices**: (in ‘TotalMatrces.f’, refer to *DisplacementFiitinguvw2.doc, equation 3.4*)

If NF==0

**Call DLFTDS**: matrix decomposition

NF = 1;

end

**Call DLFIDS**: to solve the fitting problem

**Call PlotDeformedMeshNPoints(IP)**

**Call CalculateVolumeChange**

**End for the big loop**

More details on **PlotDeformedMeshNPoints(IP)** in PlotDeformedMeshNPoints.f

From line 364-384, only plots the surface mesh

**DisplaceFiled2()** : *obtained the fitted displacement field*

**Call uvw\_to\_xyz**: *coordinate system transformation*

**Call coordinateVectors**: *calculate the matrix Ttrans in equation 7, refer to strain.doc*

**Call DisplaceGradient2(dudu,dudv,dudw,…)**: refer to equation 10 in strain.doc.

dudu = d(u\_displacement)/d(u)

dudv = d(u\_displacement)/d(v)

**Call StrainField(u,v,w,…)** : Strain field calculation,

Exyz: strain filed in xyz coordinate system

L1, L2, L3, v1, v2, v3: Eigen values and Eigen vectors

Euvw: strain field in prolate spheredial coordinate system

Euvw\_al : Almansi strain field