Project Topics for ME 531

Projects Class Presentation, May 4, 2022 (10 mins., 8 slides max)

Project Report Due May 4 , 2022

Project reports should be less than 8 pages and typed including figures. You should have at least 10 references. A pdf copy via e-mail would be fine.

(1) A thorough literature review of strain rate effects on mechanical response (consider very high strain rates as well). Show an example of strain rate demo via WARP3D.

(2) Consider the MTS model- Investigate its utilization for different materials. Find representation of 5 different materials with MTS and explain the behaviors.

(3) Compare the latent hardening matrix from Bassani versus Pierce+Asaro+Needleman with a simple example.

(4) Use the Ti cp model in WARP3d? Illustrate with a simple example.

(5) Use the Hydrogen Model in WARP3D? Illustrate with an example on a single element.

(6) A survey of pressure effects on materials- recent papers (include very high pressures) for bcc metals. Discuss non-Schmid behavior. How does yield strength change with pressure and how does elastic moduli change with pressure?

(7) Cyclic hardening or softening and how is it incorporated into the constitutive equations (survey).

(8) Modeling the stress- plastic strain behavior of a bimaterial interface (two grains of different orientations). You may use WARP3D to illustrate.

(9) Solution of problems where the elastic modulus is a function of strain (literature survey, second order terms in elasticity, few examples)?

(10) Using LAMMPS, the copper Mishin potential and the input.in file and using the run_parallel.txt, determine the change in potential energy of the system as a function of increasing crack length. Move the cylindrical void to the surface and change its dimensions to make a crack.

(11) Consider the CT and SEB geometries from WARP3D. Determine the crack tip stress-strain fields under lsy and ssy allowing crack tip plasticity.

(12) Using the Cantilever Example in WARP3D, please deform the cantilever under increasing loads and observe the growth of the plastic zone.

(13) Explain the Kroner's idea of lattice incompatibility and other relevant papers?

(14) Review of deformation (ratcheting) models relevant to contact loading (the importance of constitutive models)

(15) Using LAMMPS, the Cu Mishin potential, determine the elastic constants for the cubic crystal and compare the values with the literature. How well does this potential capture the C11, C12 and C44.

(17) Any of the example problems in the Verification Folder of WARP3D and include a good discussion/analysis of results.

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(19) A survey of methods to determine the dislocation core size with MD simulations. Insert a screw dislocation in BCC and relax it in LAMMPS and plot the differential displacement maps. Fit the results to see if the inversetan disregistry function works well?

(20) Try to set up a single hcp crystal in LAMMPS, pull the crystal in [0001] direction. Use Mg or Ti potentials. Do you observe slip/twinning?

(21) A project of your choice after consultation with me.