CE 597: Meshfree Methods & Advanced Computational Solid Mechanics
Department of Civil and Environmental Engineering
Spring 2017

Course Description
Meshfree methods, eXtended and generalized finite element methods, isogeometric analysis, large deformation analysis of nonlinear structures, constitutive models, computational inelasticity, methods for plates and shells, methods for fracture, incompressible materials, Eulerian description of conservation laws. Stability, accuracy and convergence.

Time and location:
Tuesday, Thursday 1:35 PM – 2:50 PM
Willard Building 167

Instructor
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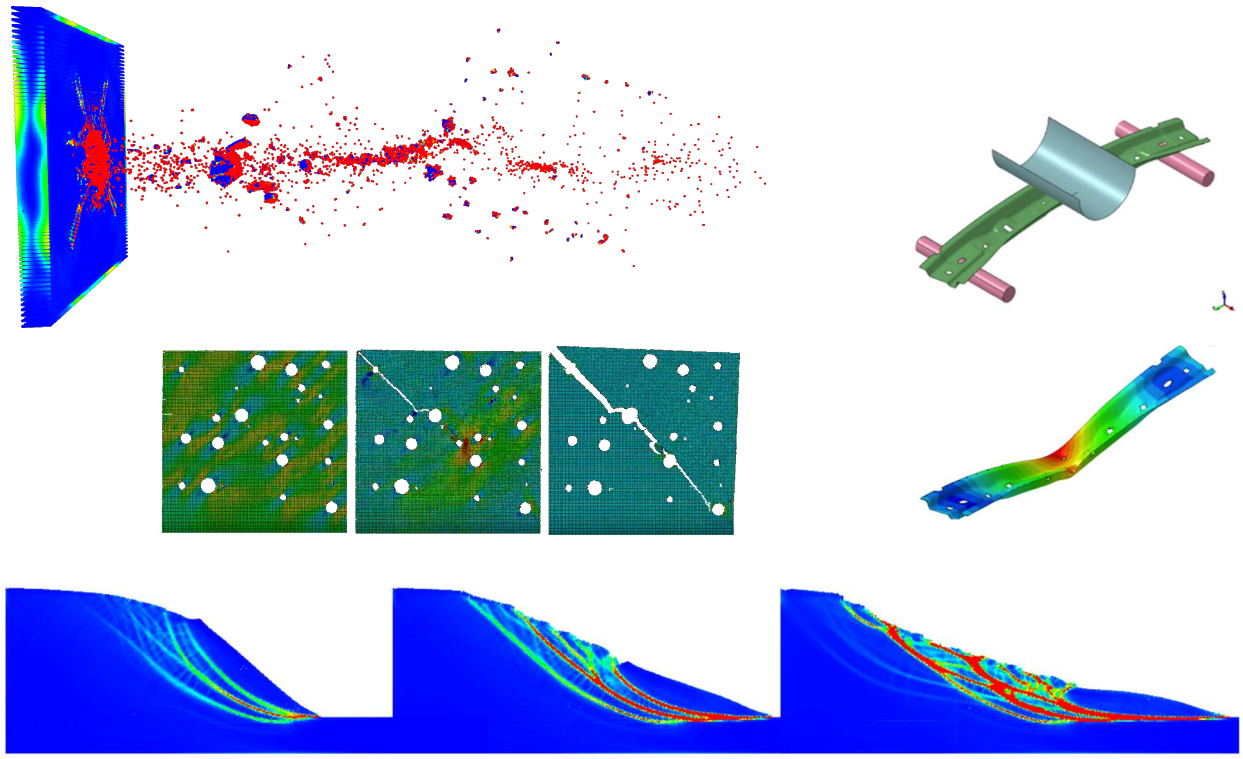
Textbook and References
- Main reference:
  Lecture notes
- Textbook (not mandatory)
  - Meshfree Particle Methods, by Shaofan Li
  - Nonlinear Finite Elements for Continua and Structures, by Ted Belystchko, Wing Kam Liu, Brian moran, and Khalil Elkhodary



Course Outline

1. **Galerkin meshfree methods**
    a. Least-squares approximations
    b. Kernel approximations
    c. Derivative approximations
    d. Smoothed particle hydrodynamics (SPH)
    e. Element Free Galerkin method (EFG)
    f. Reproducing kernel particle method (RKPM)
    g. Properties of meshfree methods
2. **Isogeometric analysis**
    a. B-splines
    b. NURBS
    c. Galerkin isogeometric analysis (IGA)
    d. Properties of isogeometric analysis
3. **Material point method**
    a. Sulsky's original method (MPM)
    b. Generalized interpolation material point (GIMP) method
    c. Convected particle domain interpolation (CDPI) method
    d. Properties of MPM methods
4. **Partition of unity (PU) methods**
    a. *hp* clouds
    b. Generalized finite element method (GFEM)
    c. Global-local finite element method (FEM^{gl})
    d. eXtended finite element method (XFEM)
    e. Properties of PU methods
5. **Large deformation analysis of nonlinear problems**
    a. Lagrangian method for hyperelasticity
    b. Lagrangian method for plasiticity
    c. Semi-Lagrangian meshfree method
    d. Von Mises and Drucker-Prager plasticity models
    e. Computational elasticity
6. **Imposing boundary conditions**
    a. Strong enforcement
    b. Weak enforcement
7. **Domain integration**
    a. Gaussian Quadrature
    b. Stabilized conforming nodal integration
    c. Other stabilized nodal integrations
    d. Variationally consistent integration
8. **Strong form collocation meshfree method**
    a. Radial basis functions
    b. Radial basis collocation method (RBCM)
    c. Reproducing kernel collocation method (RKCM)
    d. Weighted collocation methods
9. **Techniques for special problems**
    a. Kirchhoff-Love plates
    b. Mindlin-Reissner plates
    c. Fracture
    d. Incompressible materials
    e. Eulerian description of conservation laws