Rock Damage & Geostorage
Vertically Integrated Program
Georgia Institute Of Technology

Dr. C. Arson
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VIP: Rock Damage Modeling and Energy Geostorage Simulation – Fall 2016

Meeting Times: Monday 4.05pm-5.25pm
Classroom: Klaus VL-465
Office Hours: by appointment

Research Goals: To predict soil and rock behavior exposed to high stress coupled with reactive fluid flow and temperature gradients, and for sustainable and performing geo-energy and geo-storage systems.

Research Teams:

1. **FEM simulation of fracture patterns and root networks ("network")**
   - Numerical prediction of the mechanical integrity of girder beams with initial damage - G-DOT
   - Calibration of a tool coupling continuum damage mechanics and Cohesive Zone Models – NSF
   - Benchmark between XFEM, CZM and joint elements for modeling crack propagation, coalescence and crack-interface interactions – NSF
   - Programming of hydro-mechanical CZM models – NSF
   - Prediction and optimization of plant root architecture deployment around obstacles – NSF
2. **Micro/macro modeling of damage and healing in salt rock ("healing")**
   - Temperature- and moisture- controlled creep tests on granular salt – NSF
   - Microscope & CT scan image analysis & statistical description of microstructure – NSF
   - Mathematical modeling of damage and healing from microstructure descriptors – NSF
   - MATLAB programming for damage and healing models at the sample scale – NSF
   - Finite Element simulation of salt rock damage and healing around cavities - NSF
3. **DEM simulation of particle crushing and granular microstructure evolution ("crushing")**
   - Discrete Element simulation of ballast particle crushing – U.S. Assoc. Railroads (AAR)
   - Geometric description and modeling of microstructure changes during particle crushing - AAR
   - Continuum-based prediction of energy dissipation by crushing with MATLAB - AAR
   - Numerical optimization of microstructures - AAR

Damage Poro-Mechanics Laboratory Team (DeeP MeLT):

Dr. Chloé Arson <chloe.arson@ce.gatech.edu> - Associate Professor
Mr. Koochul Ji <koochul@gatech.edu> - M.Sc. student, co-lead of the network team
Mr. Wencheng Jin <wencheng.jin@gatech.edu> - Ph.D. student, lead-advisor of the network team
Dr. Jia Lin <jia.lin@boku.ac.at> - Visiting scholar, member of the network team
Mr. Fernando Patino <fp@gatech.edu> - Ph.D. student, co-lead of the healing team
Mr. Xianda Shen < xdshen@gatech.edu> - Ph.D. student, lead advisor of the healing team
Mr. Pei Wang <peiwang@gatech.edu> - Ph.D. student, lead advisor of the crushing team

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VIP Organization: (assuming 10 VIP students)

1. Three Wikipage masters (collection of research deliverables, archiving, wiki design)
2. Five VIP meeting reporters (note taking and archiving)
3. Two symposium coordinators (presentation program, discussion moderation, catering)

Team composition and VIP organization will be announced and discussed during the first VIP meeting. Related information will be summarized in the VIP meeting reports that will be posted on the Wikipage.

Tentative Schedule: The table below provides some milestones. It will be updated as needed, according to the progress made on research projects. Depending on group's availabilities, social events may be planned outside of the regular meeting times.

Week	Milestones	Agenda
08/22	Organization	Team mentors present the objectives for the semester. VIP students are assigned a research team and choose a group role (wikipage, reporting, or symposium). Research teams define regular meeting times outside of the energy geotechnology VIP meeting.
08/29	Research plan	VIP students present their research plan for the semester as individuals, and as a team.
09/05	*Labor Day*	*No meeting.*
09/12	Presentation 1	Presentation by the "healing" team (30'), progress review.
09/19	Presentation 1	Presentation by the "network" team (30'), progress review.
09/26	Presentation 1	Presentation by the "crushing" team (30'), progress review.
10/03	Roundtable	Roundtable and independent work on subteams' projects. *Prof. Abst.*
10/10	*Students recess*	*No meeting.*
10/17	Short paper	VIP students prepare a paper of 2,000 words as a team. Overview of the progress made by each team. Updates on the research plan. Design notebooks collected for advisory grading. On-line peer-evaluations due.
10/24	Presentation 2	Presentation by the "healing" team (30'), progress review.
10/31	Presentation 2	Presentation by the "network" team (30'), progress review.
11/07	Presentation 2	Presentation by the "crushing" team (30'), progress review.
11/14	Final Paper	VIP students prepare a paper of 5,000-8,000 words as a team. Overview of the progress made by each team. Plans for future research.
11/21	Symposium	Each team makes a 20 minute research presentation. Design notebooks collected for final grading. On-line peer-evaluations due.
11/28	Debriefing	Debriefing of the research semester. Plans for future research.

Grading: The grade is based on three areas:

1. Personal accomplishments to the sub-team goals (33%): mostly through research deliverables (e.g., portions of code, literature reviews, simulation work)
2. Teamwork (33%): mostly through participation to VIP and sub-team meetings, contributions to the VIP organization, assistance to other VIP members, team presentations, peer-evaluations
3. Documentation and records (33%): mostly through the design notebook and contents contributions to the Energy Geotechnology Wikipage

Final grade: $F<60\% \leq D<70\% \leq C<80\% \leq B<90\% \leq A \leq 100\%$

Note: Templates of the peer-evaluation form are available on the VIP website.

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Labs and facilities: VIP has rooms and equipment that are shared by many VIP teams. In order to provide a good working environment, the following rules apply to anyone with access to these rooms and equipment:

1. The room priorities are:

a. Scheduled team meetings and lectures/learning modules
b. Weekly Sub-team meetings
c. Other project-related work

While these priorities indicate which events take precedence, a good neighbor policy on using the rooms applies. If you need to access computers, equipment, or work on project work in the room while other activities are going on (team meetings, etc), you are welcome to do so as long as it does not disrupt the schedule activities. Similarly, multiple groups may use a VIP room for other project related work. Also, where is does not disrupt one of the above uses, VIP participants may use the rooms for other activities such as studying.

2. Everyone is expected to pitch in to keep the rooms clean. Faculty/team advisors do not appreciate having to clean up after students. Food is allowed in the rooms provided any spills or messes created are cleaned up. Gum is a particular problem especially in carpeted rooms. Do not place used gum anyplace other than wrapped in a trash can!

3. The rooms have equipment both for general use and for specific teams. General use equipment includes the projector in Klaus 1440, and the display in VL 465. Other equipment may be general use or dedicated to a team specific purpose (some equipment may be general use one semester and assigned to a team another semester). You should not use team-specific equipment except for the designated purpose. If you are uncertain whether the equipment is available for general use then you need to determine that it is available and appropriate for you to use before using the equipment. Some equipment may pose hazards if used inappropriately!

a. Equipment may not be removed from a VIP room without filling out a written record approved by the appropriate team advisor.
b. You will be responsible for the replacement cost of any equipment not returned in good condition.
c. You must be sure you know how to operate the equipment safely. Written approval to use the equipment does not indicate that the team advisor has reviewed equipment use and safety. You are responsible for knowing the hazards and safe operation of any equipment you use.

4. Computer accounts are issued for your use only. You may not share computer accounts with anyone else, even another team member. All computer usage is subject to rules and policies of Georgia Tech, the University System of Georgia Board of Regents, and the State of Georgia. Additionally, you are expected to be considerate of other users. Computer permissions are not authoritative. For example, just because you have file access to something does not indicate that it is appropriate for you to read or modify that file.

5. Buzz-card access to VIP facilities is a privilege contingent on abiding by the above rules. Buzz- card access is logged. Be aware that if there is a problem (theft, vandalism, or simply a mess left in a room), the logs will be consulted. Do not allow unknown people to access VIP facilities. Be sure to secure the facilities (i.e., close the door) when you leave.

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Academic Honesty: The main principle in VIP academic honesty is that you will not present someone else's work as your own. Tests and specific assignments (homework, lab assignments, etc) must be your own work. For other work you are encourage to consult whatever sources are helpful in learning and understanding the issues associated with the material, but you should always provide appropriate references and citations where such material is included in your design notebook, programming code, presentations, etc.

Additionally, to provide a good working environment for all students, you're expected to adhere to rules given here, posted, or disseminated in class. Academic Honesty is taken seriously and failure to follow these principles will result in disciplinary actions as given in the Student/Faculty Handbook.

Education Research: The instructors of this course are conducting research that involves the collection of course artifacts (examples of work that students complete and submit). As part of this research, the instructors may correlate these artifacts with student data such as standardized test scores (SAT or ACT for example), grades in previous courses in high school or college, and demographic information. Students are free to "opt out" of this research and not have their artifacts included as well as to have their individual information excluded from the student data that is collected. If you do not wish to participate in this research, send an email jmelkers@gatech.edu and copy the GA Tech IRB at IRB@gatech.edu to opt out. Please let the instructor know if you have any questions.