Industrial Projects offered by Professor Jonathan Black:

**General Notes:** Prof. Black supervises M.Eng. design projects on a team basis, with the intention of providing a group experience that closely replicates industrial design activities. The chartering of any one team depends upon the appropriate group of students, with individual skill sets, being available for that project. The attached project briefs are correct as of 7/10/12 but are subject to change. Several others are under discussion and Prof. Black is open to considering student initiated design problems.

**Schedule:** A full presentation concerning each project will be made during MEng orientation on Monday, August 13. Prof. Black will be available during the following week for individual discussions (Weill 406); enquiries may be made by email: jb2245@cornell.edu.

Prof. Black will be holding extended, open office hours Tuesday August 21, 10:30a – 12:30p in Weill 221. Teams will then be selected and finalized within 24-48 hours. Students interested in any of these projects should email the following information to Prof. Black, as soon as possible:

1. Projects desired, in order of preference.
2. Summary, by course titles, of courses you took during your Junior and Senior years as an undergraduate.
3. Title and date of any academic degrees (or other professional preparation) that you have completed post-High School.
4. Particular personal skills that may be applicable: foreign language reading/translation abilities, graphics and/or FEA program familiarity, etc.
5. Best way to contact you (as well as email address, and AIM or Skype name).
6. A brief personal statement touching on:
   a. Reasons for electing to enter the M.Eng program at Cornell.
   b. Reasons for selecting the particular design project (primary choice).

Primary initial objective after completing the M.Eng degree.

3) Project Title: *In Vitro Anterior Cruciate Ligament Mechanics Simulator*

Sponsor: Dimensionless Innovations
Contact: Abhiram Varadarajan, abhiram.v111@gmail.com/Project advisor is Jonathan Black

**Problem Statement:**

Anterior Cruciate Ligament (ACL) injuries are extremely common (250K+ annually) and ACL reconstructions are the 6th most common surgical procedure in the United States. The incidence rate of this injury is increasing annually throughout the world. Efforts at optimizing surgical reconstruction and subsequent rehabilitation procedures have been hampered by the lack of an accurate *in vitro* physical model of the ACL that mimics the ligament’s intrinsic and extrinsic behavior across its range of motion (knee flexion-extension and internal rotation) in the native *in vivo* environment. The sponsor is developing the first of a planned line of devices to aid surgical reconstruction and needs such an *in vitro* model for testing and calibration purposes before in vivo pre-clinical trials can be initiated.
**Project field:** Problem and application analysis, functional design, instrumentation, in vitro testing, biomaterials/biomechanics (orthopaedic)

**Team requirements:** This is a team project for 3-5 people with various engineering backgrounds, including electrical and mechanical. Some undergraduate training in biology and FEA would be an advantage in one or more team members.

**Project elements:** The project will be conducted as a classical design project:

- Background and literature research
- Define problem
- Analyze key performance aspects and specify target parametric values (and criticality)
- Develop alternative design approaches
- Screen for feasibility and elect one or more designs to elaborate
- Fully develop selected alternative(s)
- Perform pilot testing (either in laboratory or by FEA simulation) to obtain initial values of target parameters
- Fully evaluate completed designs and selected preferred one
- Fabricate and functionally test a prototype design*
- Prepare and present final report

There will be periodic intermediate design reviews. A final design report (with design history) will be written by the team and presented in a formal final public design review. There will be opportunities to meet with experts, including surgeons and technical representatives.

Mentors: Professor Jonathan Black ([jb2245@cornell.edu](mailto:jb2245@cornell.edu), skype: jonathan.black39), sponsor representative Abhiram Varadarajan, ([abhiram.v111@gmail.com](mailto:abhiram.v111@gmail.com), skype: abhiram.varadarajan), Surgeon (TBD)

*Note: This project will operate on an accelerated design schedule with a secondary goal of producing a working prototype of the selected design before the end of the Spring ’13 semester*