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).
   c. Primary initial objective after completing the M.Eng degree.

7). Project Title: *In Vitro Simulation and Evaluation of Total Hip Replacement Component Insertion*  
Sponsor: Stryker Orthopaedics, Mahwah, NJ  
Contact: Matt Poggie ([Matt.Poggie@stryker.com](mailto:Matt.Poggie@stryker.com)) – Jonathan Black is the project advisor

**Problem statement:**

During the design and development of acetabular and femoral components for total hip replacement (THR), extensive static and dynamic laboratory testing must be performed before animal or patient trials may begin. The principle purposes of these studies are examination of the dimensional stability of components under load and prediction of the initial and continuing stability of component fixation to bone. Contemporary methods use a variety of support geometries, utilizing various porous and non-porous materials to simulate bone, in universal testing machines. However, these approaches fail to accommodate adequately for varying qualities of bone encountered in patients, for varying geometry of the surgically prepared bony bed and for the physiological environment encountered in service.
The aim of this project will be to design and develop an improved *in vitro* mechanical simulation procedure for a specific component or component class produced by the sponsor. The project will run on an accelerated schedule so as to permit prototype construction and limited experimental validation during the Spring ’13 semester.

**Project field:** Problem and application analysis, material and process design, in vitro testing, biomaterials/biomechanics (orthopaedic)

**Team requirements:** This is a team project for 3-4 people with various engineering backgrounds. Some UG training in biology would be an advantage for one or more team members. This would be a good project for a mechanical engineer with some industrial design experience, especially with FEA software.

**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 testing to obtain initial values of target parameters
- Functionally test (*in vitro*) prototype assemblies
- Fully evaluate completed designs and select preferred one
- 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 design review. There will be opportunities to meet with experts, including surgeons and technical representatives.

Mentors: Prof. Jonathan Black (jb2245@cornell.edu, Skype: jonathan.black39), Sponsor Matt Poggie (mailto: Matt.Poggie@stryker.com)