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.

1) Project Title: Dispenser and Packaging System Design for Novel Conformable Structural Bone Graft Substitute
   Sponsor: Ultramet, Pacoima, CA
   Contact: Art Fortini/Jonathan Black is the CU contact

Problem statement:

Many orthopaedic procedures are handicapped by deficiency of host cortical and cancellous bone. In addition to traditional (auto-, allo- and xeno-) grafts, biomaterials have been developed as partial replacements for structural (cortical) bone. These all share a functional problem: if they are remodeled and replaced by the host, as is generally desired, they undergo a period of greatly reduced strength and stiffness during which they may fail (metallic bone graft substitutes (augments) and some composites do not undergo remodeling).

In 2011-12, an M.Eng student team designed a novel, multiphase, bone graft substitute (and delivery system) with the following principal (required) characteristics:
• Moldable by hand and self-retaining in implant sites with at least 3 (of six) defect faces occluded.
• Able to bear load initially, even in partially open sites (as above).
• Able to heal to host bone and complete remodeling process without significant intermediate strength and stiffness loss.
• Able to be formed such that initial mechanical properties are controllably anisotropic

The problem now is to devise (and implement in so far as possible) a suitable mixing and delivery system for this new class of materials.

Project field: Problem and application analysis, material and device design, in vitro testing, biomaterials (orthopaedic)

Team requirements: This is a team project for 2-3 people with various engineering backgrounds. Some UG training in biology 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 testing (either in laboratory or by FEA simulation) to obtain initial values of target parameters
  • Fully evaluate completed designs and select preferred one
  • Develop a working prototype.**
  • 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: Prof. Jonathan Black (jb2245@cornell.edu, skype: jonathan.black39), Art Fortini (Sponsor representative) (art.fortini@ultramet.com) and Surgeon (also to be named)


** 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