IDEAS FOR STUDENT PROJECTS: Academic year 2015/16

Note: These itemized topics are not intended as outlines for research, although some might qualify. Instead they are suggestions for inclusion under various topics. Mixing and matching of topics to formulate a suitable project that matches student interests with faculty expectations is expected.

TECHNOLOGY DEVELOPMENT, TECHNOLOGY ASSESSMENT, TECHNOLOGY EVALUATION

1. Mammography Topics:
   a. The current issue: 3D mammography evaluation design issues
      i. Comparison arm(s)
      ii. Endpoints
      iii. Potential biases
      iv. Is the design used to evaluate Film-Screen v Digital mammography appropriate?
   b. History of technology development and assessment
      i. From industrial to clinical application
      ii. Uncontrolled evaluations
      iii. Radiation issues
      iv. Key actors
      v. Politics
      vi. Government
      vii. Interest groups/advocates
      viii. U.S. v Canadian and European approaches
   c. Future directions
      i. Competing/complementary technologies
      ii. Specialty applications of technologies
      iii. Impact of the Affordable Care Act

2. MRI Technology assessment for:
   a. Colon imaging
   b. Brain imaging
      i. Parameterization issues
      ii. Practical clinical issues
      iii. Cost/Benefit issues

ORGAN SPECIFIC CANCERS; EARLY DETECTION TECHNOLOGY DEVELOPMENT

1. Ovarian Cancer; rare disease and silent killer
   a. Epidemiology
      i. Risk factors assessment
   b. Early detection technologies
      i. Imaging
      ii. Molecular biomarkers
      iii. On the horizon
   c. Carcinogenic pathways

2. Bladder Cancer; not so rare but high hazard
a. Epidemiology
   i. Risk factors
   ii. Relationship to benign hypertrophy and prostate cancer
   iii. Prognostic pathology
   iv. Survival/hazard function
b. Early detection technologies
   i. Imaging
   ii. Molecular markers
   iii. On the horizon
c. Carcinogenic pathways
3. Pancreatic Cancer; rare disease and aggressive killer
   a. Epidemiology
      i. Risk factors assessment
   b. Early detection technologies
      i. Imaging
      ii. Molecular biomarkers
      iii. On the horizon
c. Carcinogenic pathways

TECHNOLOGY ASSESSMENTS

1. Personalized Medicine
   a. Genetic predispositions
   b. Genetic-linked treatment
2. Remote diagnosis and treatment
   a. Telemedicine
   b. The military model

CELLULAR ENGINEERING (mechanisms to reprogram cells for research, disease prevention or clinical management of disease)

   a. Artificial cell technology
   b. Autonomous injected site-specific, pathology-specific delivery systems
   c. Endogenous cells modified
   d. Engineered networks
   e. Control mechanisms and monitoring
   f. Pathway analysis

RNA STRUCTURE AND REGULATION

   a. Imaging
   b. Spectroscopy, NMR and other
   c. X-ray crystallography

EPIGENETIC-LINKED DISEASE MECHANISMS

   a. Cancer
   b. Birth defects
c. Chronic diseases
d. Pathways to hyper/hypo methylation

**QUANTITATIVE IMAGING APPLICATIONS AND DISEASE RISK**

a. Molecular domains
   i. Inflammation
   ii. Cellular function
   iii. Epigenetics
      1) Methylation
      2) Histone modification

**DECISION THEORY APPLICATIONS IN BIOMEDICAL ENGINEERING**

a. Shannon Information Theory
b. Sampling methods
c. Experimental design and interpretation
d. May be applied to any of the above project areas

**BME METHODS APPLICATIONS IN OTHER FIELDS**

a. Spin-offs to
   i. Physics
   ii. Materials
   iii. Math
   iv. Biology
   v. Economics
   vi. Other engineering

**LEGAL AND ECONOMIC CONSIDERATIONS** (may be applied to any of the above project areas)

a. Legal issues
   i. Liability to practitioners or clinicians
   ii. Intellectual property impediments to progress
   iii. Regulatory
   iv. Privacy
b. Economic issues
   i. Technology development costs
   ii. Private v. tax funding
   iii. Cost/Benefit decision criteria