Engineering as a Career

With James Paradise, Lockheed Martin Space Systems

February 2016

Let's Talk About Engineering

Definitions:

Engineering:

- The application of science and mathematics by which the properties of matter and the sources of energy in nature are made useful to people
- The design and manufacture of complex products

Engineer:

- One who practices engineering is called an engineer.

Credit: http://www.merriam-webster.com/netdict/engineering

Engineering Has Many Fields

- Civil
- Biomedical
- Chemical
- Aerospace
- Mechanical
- Electrical
- Software
- Systems
- Lots more disciplines not mentioned today

■ = Widely used in Aerospace

Civil Engineering

- **Civil engineering is the engineering discipline that deals with the design, construction and maintenance of bridges, roads, canals, dams and buildings.**

Burj Dubai (August, 2009)

Biomedical Engineering

- **Biomedical engineering is the application of engineering principles and techniques to the medical field. It combines the design and problem solving skills of engineering with medical and biological sciences to improve healthcare diagnosis and treatment.**

Credit: http://www.wikipedia.com

Chemical Engineering

- **Chemical Engineering applies science and mathematics to the process of converting raw materials or chemicals into more useful or valuable forms.**

Credit: http://www.wikipedia.com

Aerospace Engineering

- **Aerospace engineering is the branch of engineering behind the design, construction and science of aircraft and spacecraft.**

Credit: http://www.ksc.nasa.gov

Credit: http://www.lockheedmartin.com

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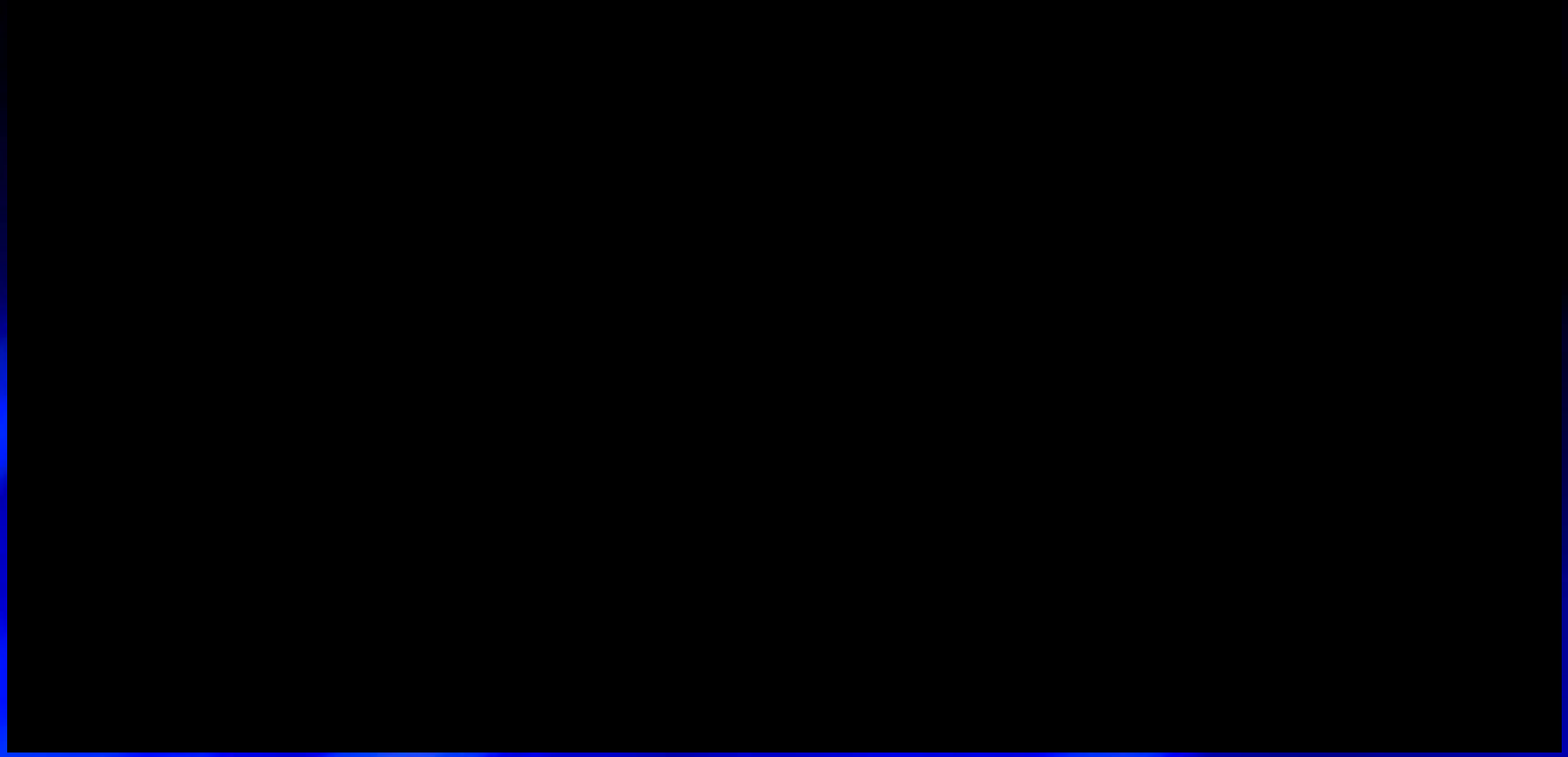
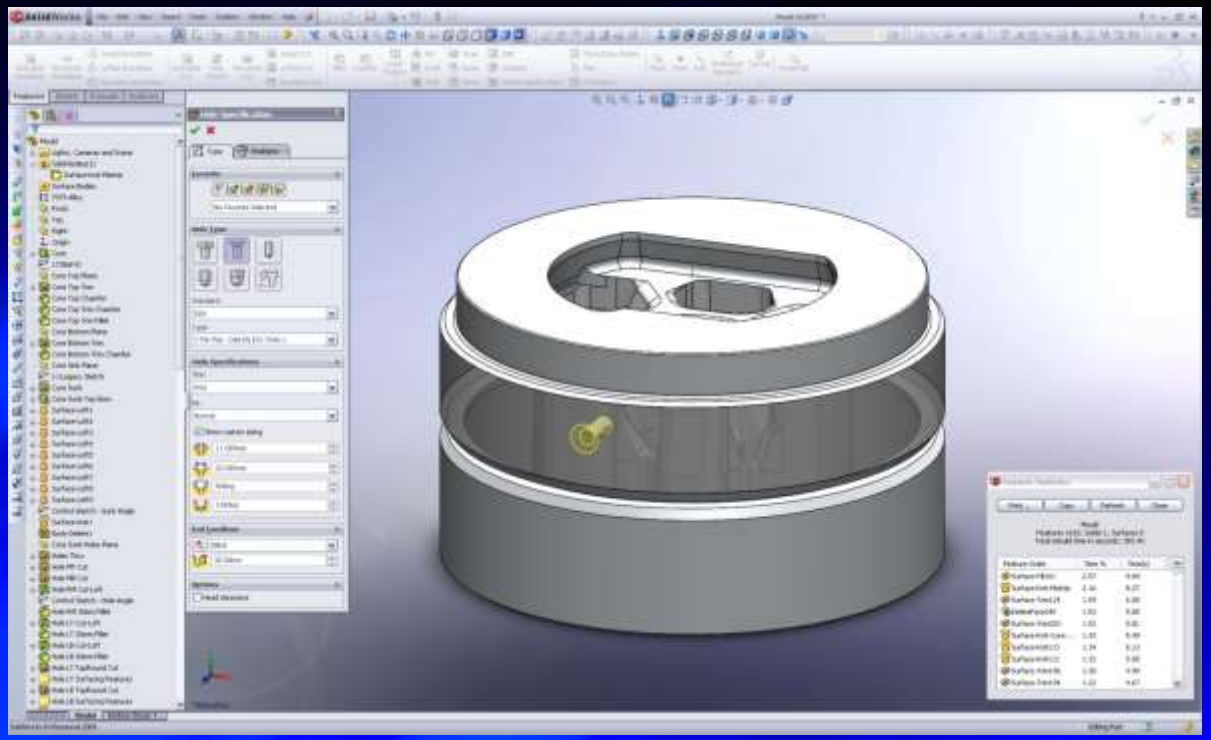
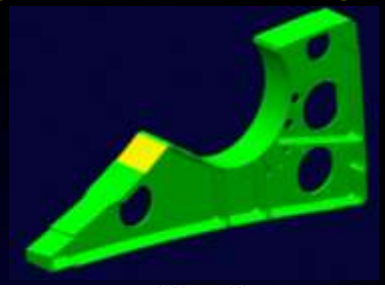
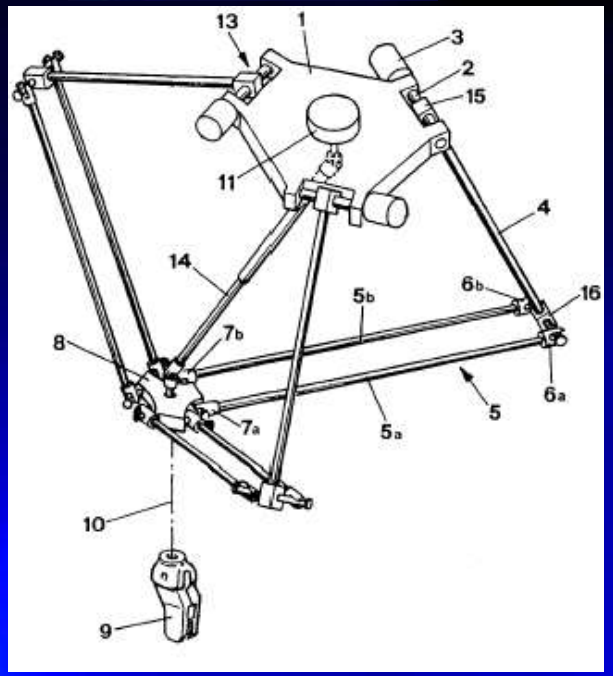


Mechanical Engineering

- **Mechanical engineering utilizes mechanics, kinematics, thermodynamics, fluid mechanics, heat transfer, materials science, and energy to design and analyze machinery and mechanical parts.**



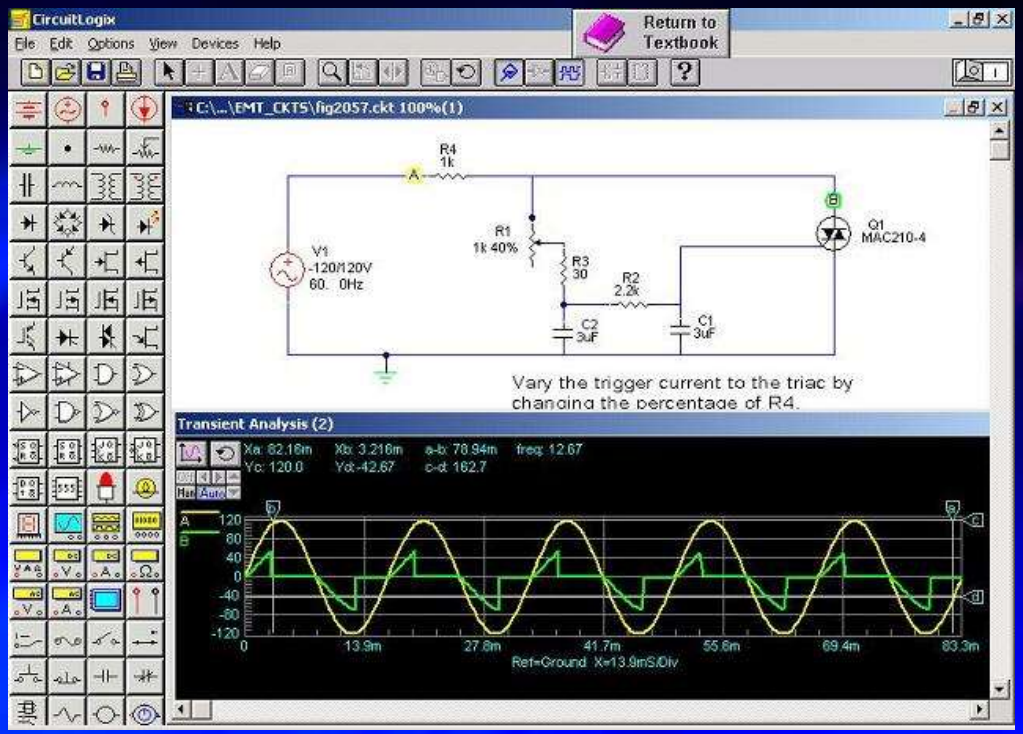




Credit: http://www.wikipedia.com

Electrical Engineering

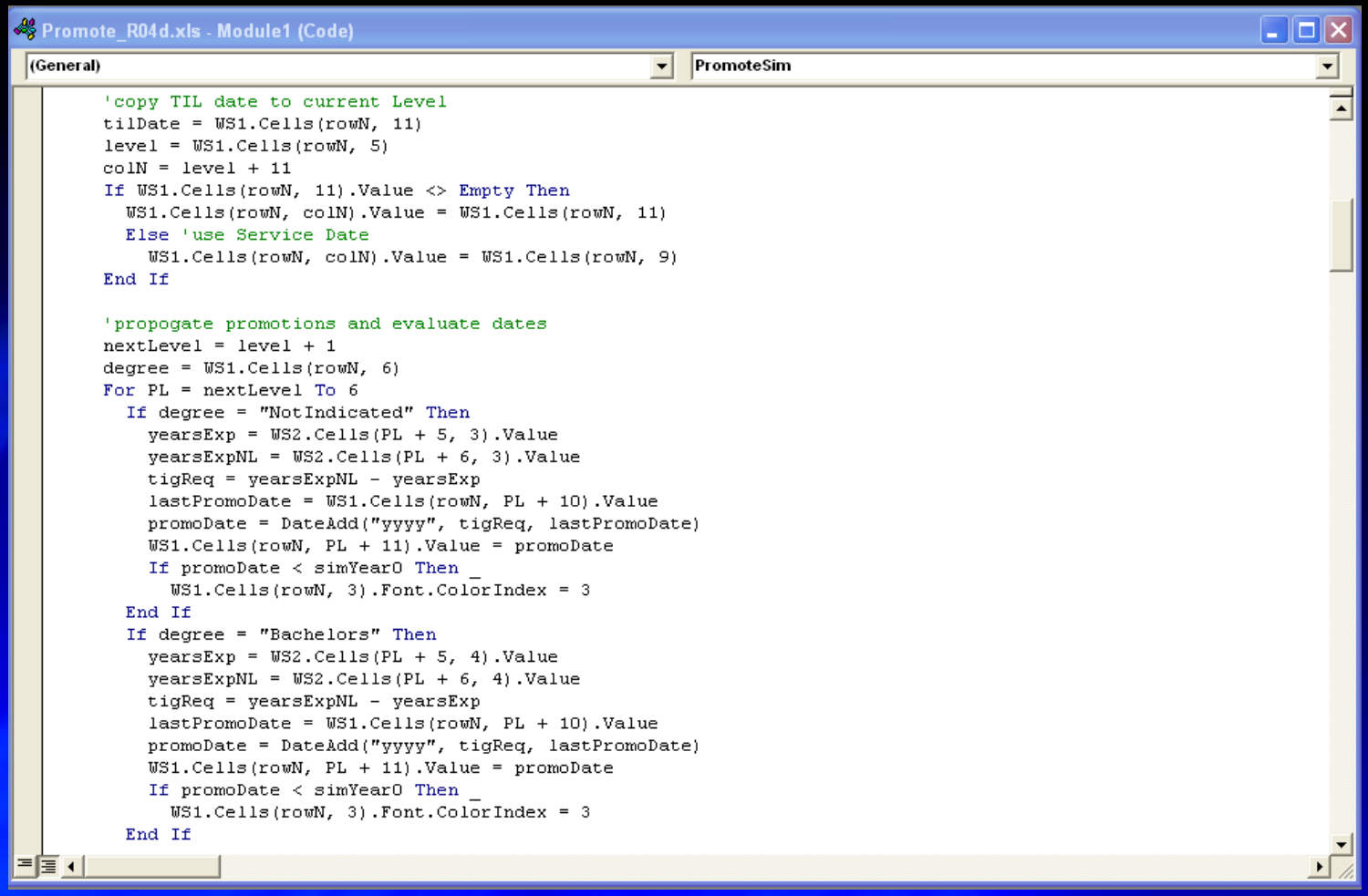
- Deals with the application of electricity, electronics and electromagnetism.
- Covers a range of subtopics including power, electronics, control systems, signal processing and telecommunications.



Credit: http://www.wikipedia.com

Software Engineering

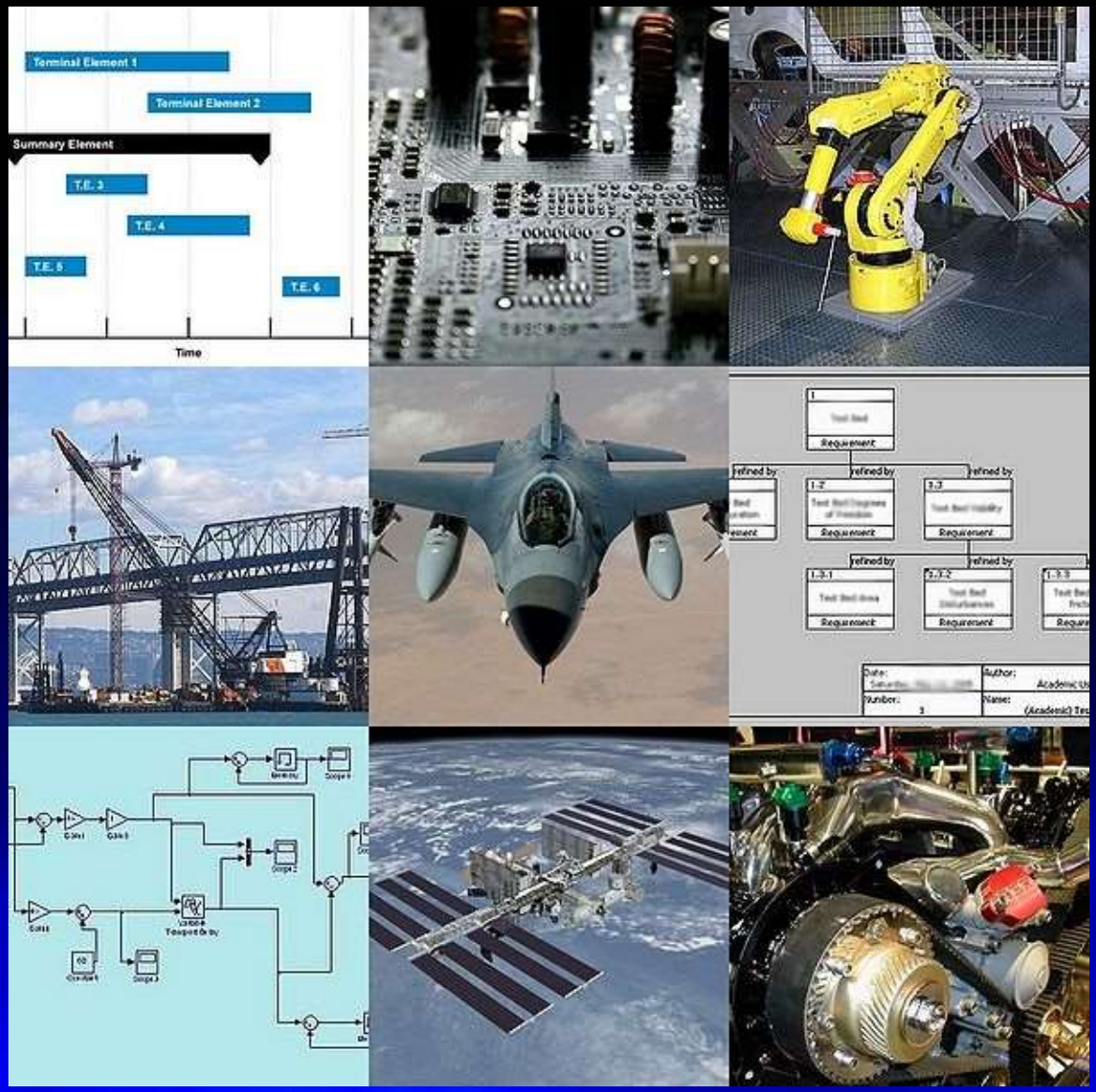
- **Software Engineering is the application that develops, tests, operates, and maintains software.**



Credit: http://www.wikipedia.com

Systems Engineering

The interdisciplinary field of engineering that focuses the integration of electrical, mechanical, and software systems.



Credit: http://www.wikipedia.com

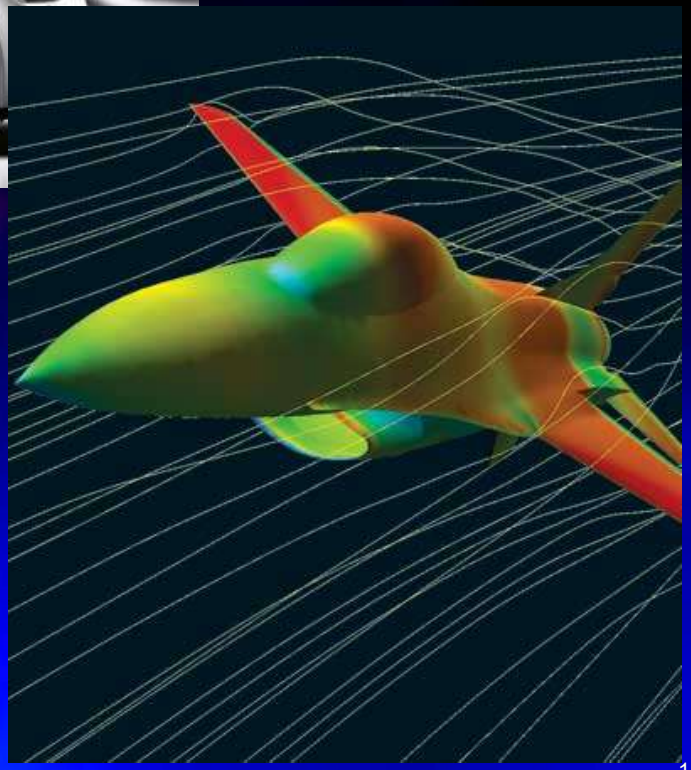
Engineering Has Many Disciplines/Specialties

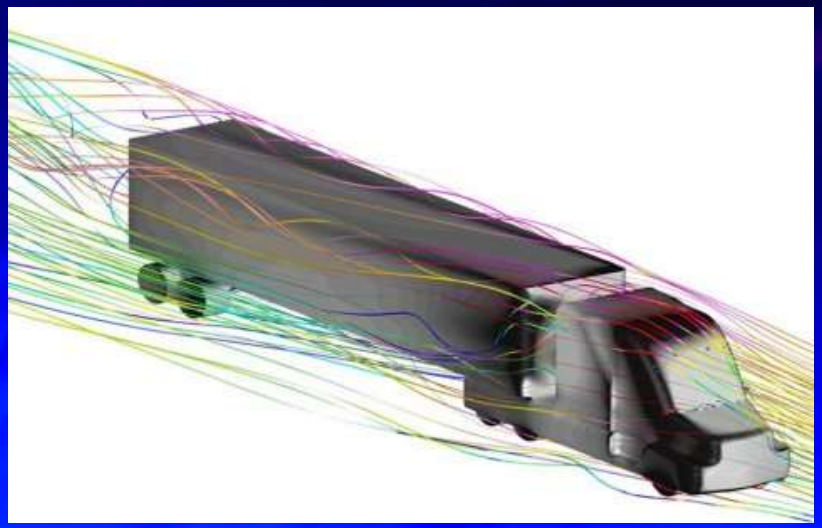
- Aerodynamics
- Fluids
- Thermal
- Stress/Loads/Dynamics
- Solar Arrays
- Batteries
- Lots more disciplines not mentioned today

■ = Widely used in Aerospace

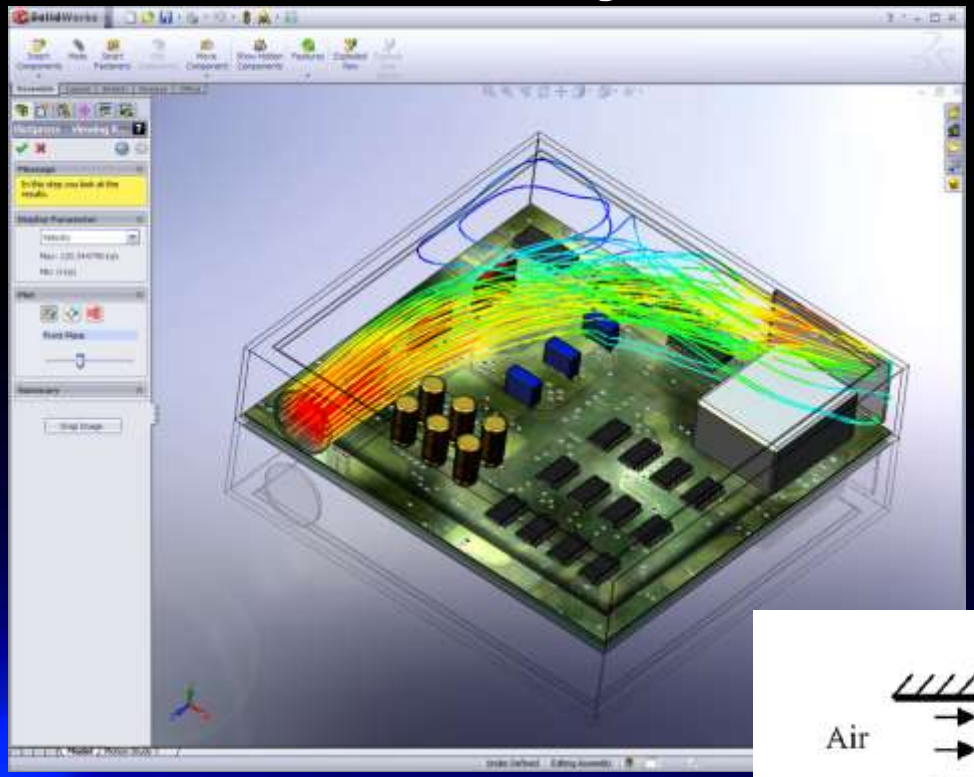
Aerodynamics

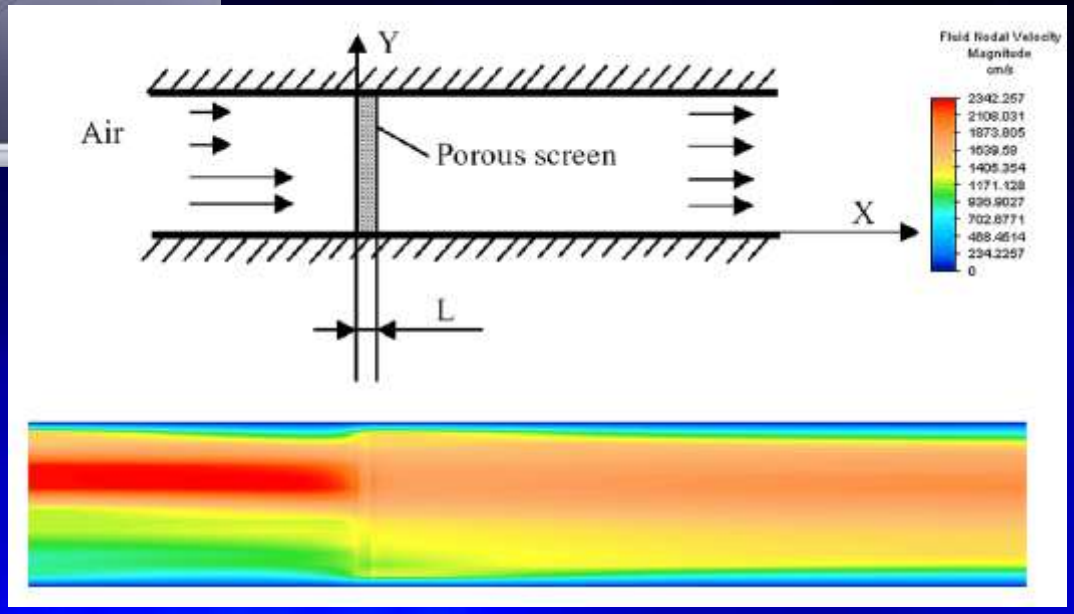
Optimize design to minimize drag





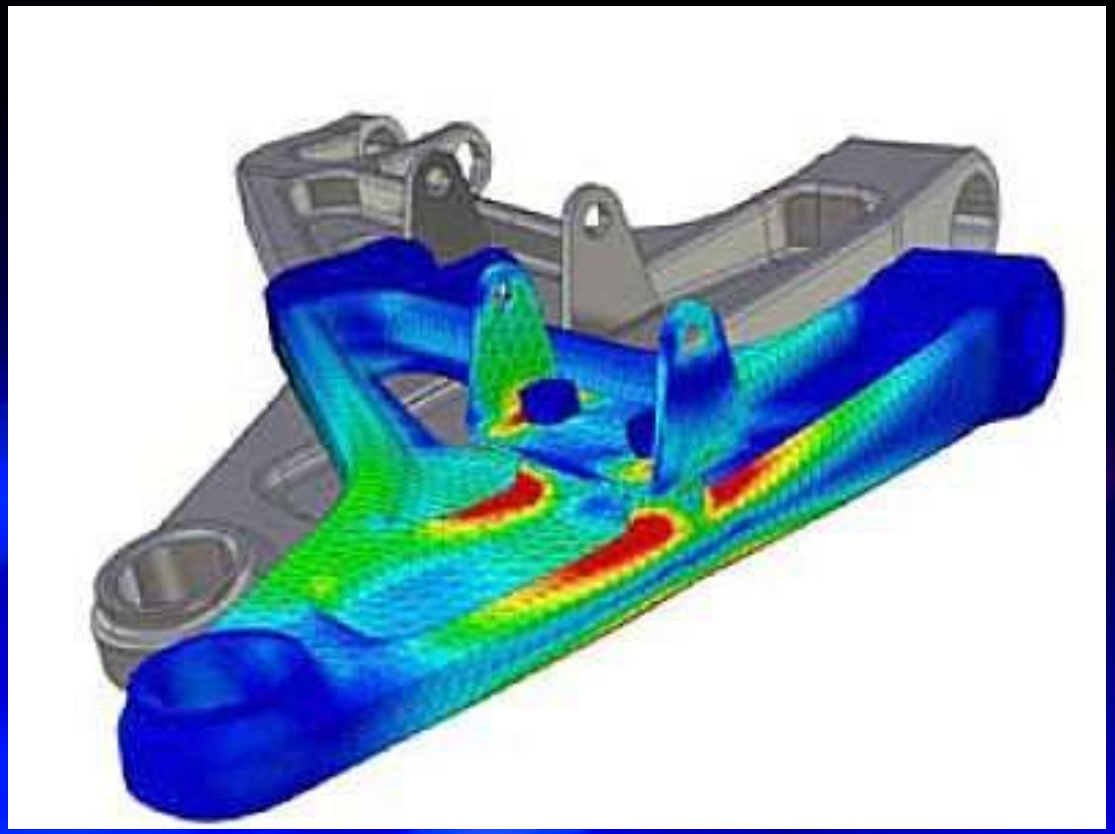
Fluid / Flow Analysis





Thermal Engineering

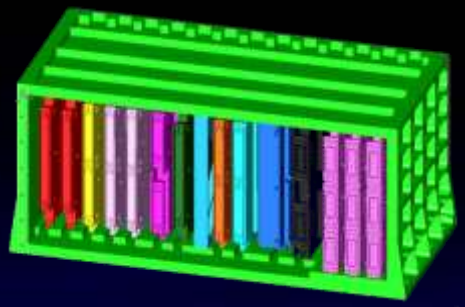
- responsible for the architecture, analysis, design, modeling, verification, technical evaluation and selection of hardware related to the thermal systems.



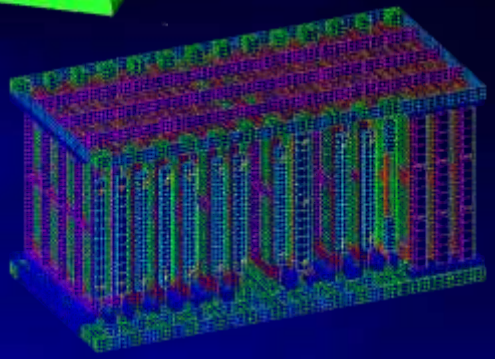
Thermal Model for a Mechanical Part

Stress, Loads & Dynamics Analysis and Test

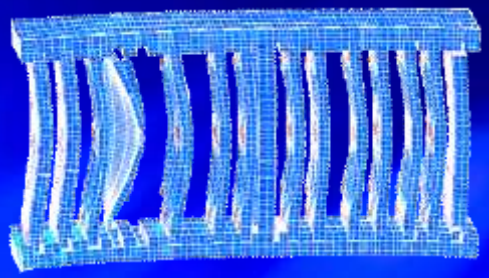
Electronics Package Analysis



Design Model



Finite Element Model



Results – Response Under Loading Conditions

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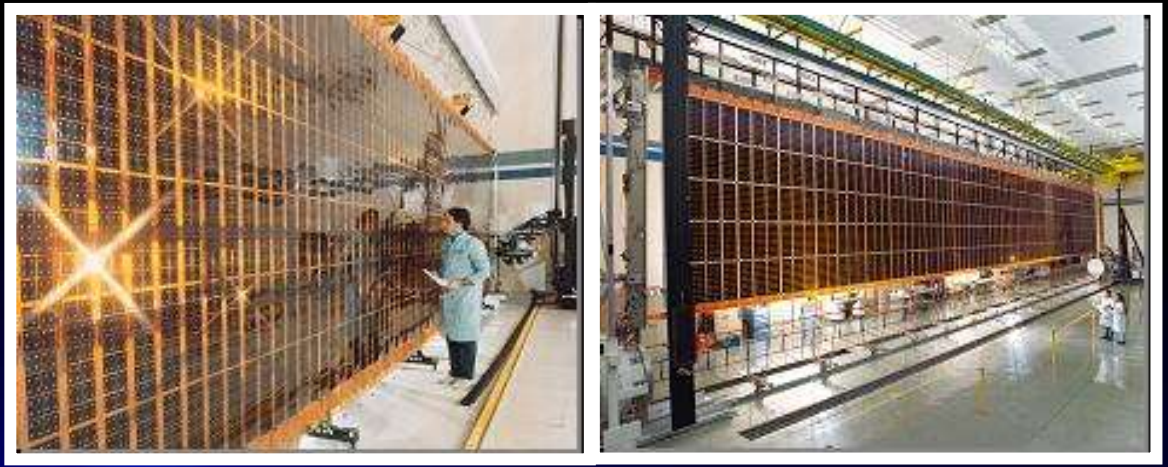
Solar Array Engineering

International Space Station



Flexible Solar Arrays

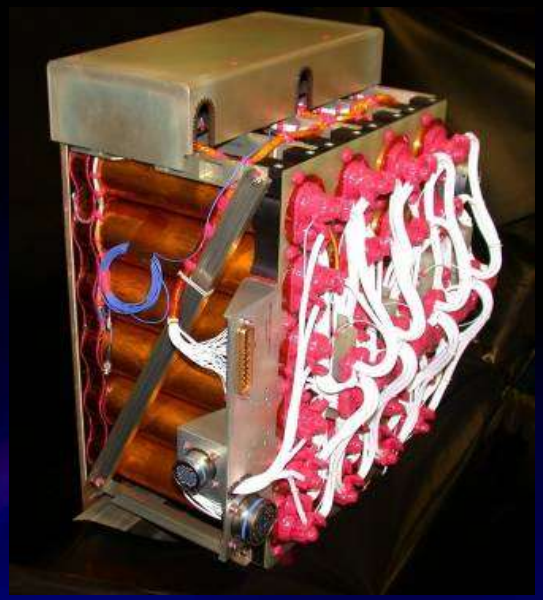
Rigid Solar Arrays

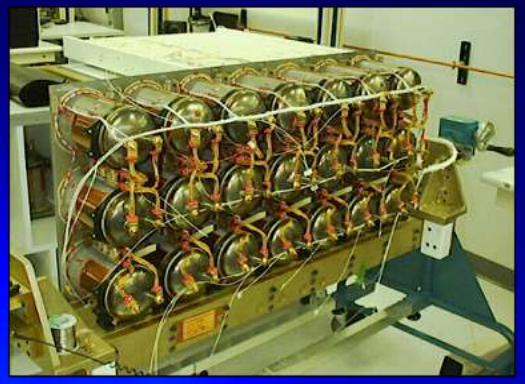
Iridium Fleet

- *Product & component design, development, qualification and acceptance*
- *Analysis - Structural, dynamics, thermal, separation, tribology, power, radiation, magnetic dipole*

Battery Design

- Battery types
  - Nickel Hydrogen / Cadmium Batteries
  - Lithium Ion / Polymer Batteries
  - Lithium Metal / Oxyhalide Batteries
  - Silver Oxide-Zinc Batteries
  - Thermal Batteries
  - Fuel Cells
- Primary and secondary batteries
- Protection Mechanisms
  - Bypass switches, TABS, redundancy mgt
  - Internal and external to cell
- Charge/Discharge management
- Thermal management



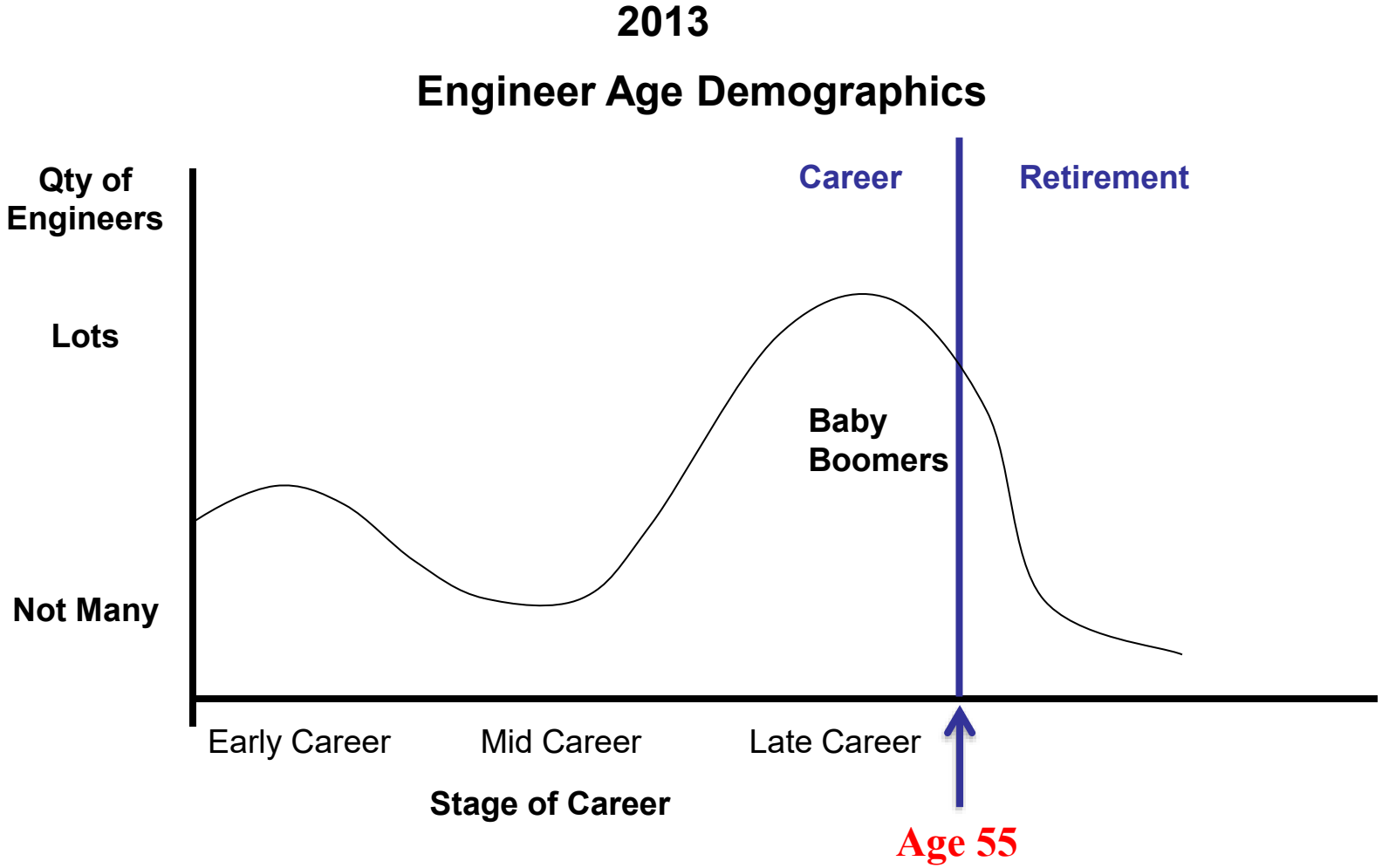


Engineering Statistics

- Engineering Jobs in United States
  - 1.5 Million
- Engineering Jobs Growth Rate
  - 10% annual growth
  - Approximately 150,000 / year
- Current Engineering Graduation Rate
  - 137,000 new engineers per year

Credit: http://www.careermarketplace.com

Engineering Career Projections
2013 – 1.5 Million Engineers



Courtesy James Paradise

Engineering Salaries

- **Starting Salaries (by Degree)**

Bachelor's	Master's

Top 20 Paying Early Career Majors

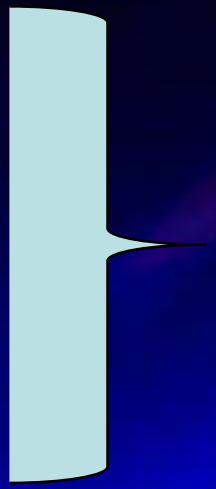
Rank	Major	Early Career Salary	Mid-Career Salary	Engineering ?	STEM?
1	Petroleum Engineering	$102,300	$176,300	Yes	Yes
2	Chemical Engineering	$69,600	$116,700	Yes	Yes
3	Computer Engineering (CE)	$67,300	$108,600	Yes	Yes
4	Nuclear Engineering	$67,000	$118,800	Yes	Yes
5	Computer Science (CS) & Engineering	$66,700	$112,600	Yes	Yes
6	Electrical & Computer Engineering (ECE)	$66,500	$113,000	Yes	Yes
7	Electrical Engineering (EE)	$65,900	$107,900	Yes	Yes
8	Aerospace Engineering	$64,700	$107,900	Yes	Yes
9	Electronics & Communications Engineering	$64,100	$113,200	Yes	Yes
10	Materials Science & Engineering	$64,000	$105,100	Yes	Yes
11	Computer Science (CS) & Mathematics	$63,200	$101,400	No	Yes
12	Mechanical Engineering (ME)	$62,100	$101,600	Yes	Yes
13	Industrial Engineering (IE)	$61,900	$97,200	Yes	Yes
14	Software Engineering	$61,700	$99,800	Yes	Yes
15	Computer Science (CS)	$61,600	$103,600	No	Yes
16	Actuarial Mathematics	$60,800	$119,600	No	Yes
17	Business Information Systems	$59,800	$85,100	No	Yes
18	Biomedical Engineering (BME)	$59,600	$92,200	Yes	Yes
19	Electrical Engineering Technology (EET)	$58,900	$88,200	Yes	Yes
20	Physics	$57,200	$105,100	No	Yes

Source: Payscale.com 4/26/2015

Skills Used in Engineering

- **Hard Skills**
  - Math
  - Science
  - Problem Solving

- **Soft Skills**
  - Communication Skills
  - Teamwork
  - Leadership Qualities
  - Creativity



Faster Progression

Credit: http://www.careermarketplace.com

Questions?