

Nobody Uses Ada

CIS-2730, Software Engineering Projects

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Desktop Programming...

- Mainstream applications everyone knows about
 - Web browsers
 - Office software
 - Email clients
 - Graphics manipulation tools
 - Program development tools
 - Zillions of others
- Any Ada?
 - Not really... a few things, but rare.

Server Programming...

- Delivering services in the cloud
 - Web servers
 - Database servers
 - File servers
 - Infrastructure servers (DNS, DHCP, etc)
 - Zillions of others
- Any Ada?
 - Not really... a few things, but rare
 - Ada would be good in this domain; it's easier to build secure software in Ada

Web Application Programming...

- Applications inside your web browser
 - Google Docs
 - GMail, Outlook WebApp, etc
 - Canvas
 - Virtually any online banking or ecommerce site
 - Zillions of others
- Any Ada?
 - Not really... some people are experimenting

Mobile Application Programming...

- Applications on your phone or table
 - Anything in Google Play Store for Android
 - Anything in iPhone App Store for iOS
 - Zillions of others
- Any Ada?
 - Not really... some people are experimenting

Game Programming

- The merger of entertainment and computing
 - World of Warcraft
 - Minecraft
 - Eve Online
 - SimCity
 - Zillions of others
- Any Ada?
 - Not really

Nobody Uses Ada

- Is Ada used in...
 - Desktop programming? No
 - Server programming? No
 - Web application programming? No
 - Mobile application programming? No
 - Game programming? No
- What else is there?!?

Embedded Systems Programming!

- A computer system embedded in something else
 - Aircraft flight control
 - Automotive systems
 - Industrial control systems
 - Medical equipment
 - Scientific instruments
 - Communications systems (TV, phone network, infrastructure hardware, etc)
 - Social infrastructure (electrical power network, water systems, etc)
 - Power generation (nuclear power stations, solar/wind power, etc)
 - Appliances (oven, refrigerator, vacuum cleaner, air conditioner, etc, etc)
 - *Zillions* of others

Who Cares About Embedded Systems?

- There are vast numbers of them!
 - Vast...
 - I mean it. *Vast!*
 - See: [EETimes - Embedded Processors by the Numbers](#)

Embedded System Characteristics

- Often highly constrained
 - Low cost, battery operated
 - Minimal memory, slow processor
- Often safety critical
 - *If the software fails, people die*
 - Aircraft flight control
 - Medical equipment
 - Nuclear power station control
- Often has real time requirements
 - Controlling objects in the real world... response to input must be timely

Programming Embedded Systems

- *C is king!*
 - A huge percentage of embedded systems are programmed in C
 - For many embedded systems programmers, there is no other language!
- But...
 - In the world of *safety critical and mission critical systems*, there is Ada
 - **Ada is designed to make programming less error prone**
 - In that world you are either using Ada, or you know about it

Who Uses Ada?

Boeing 777 Aircraft



The Eurostar Train



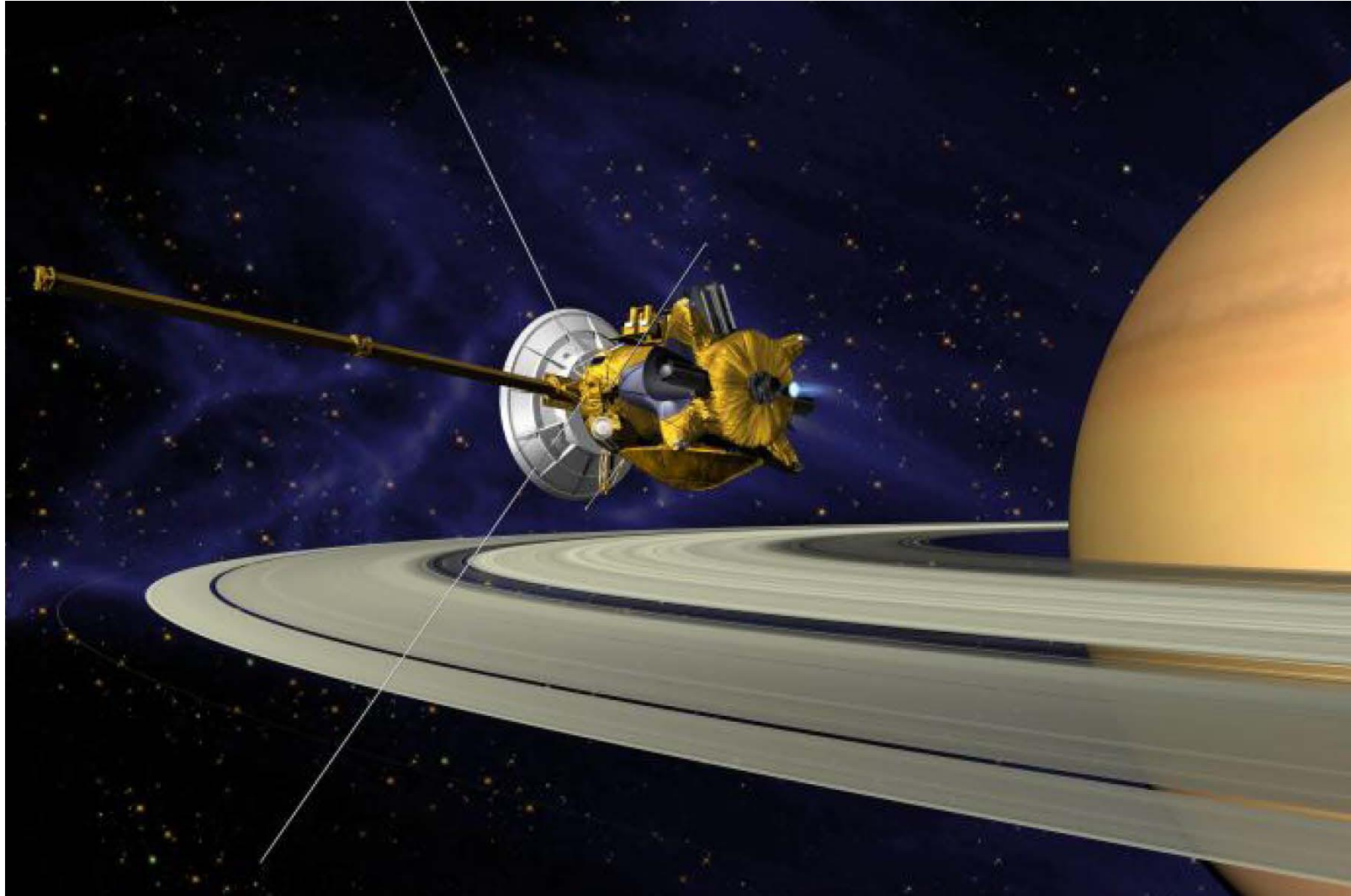
ISS Robotic Arm



US and UK Air Traffic Control



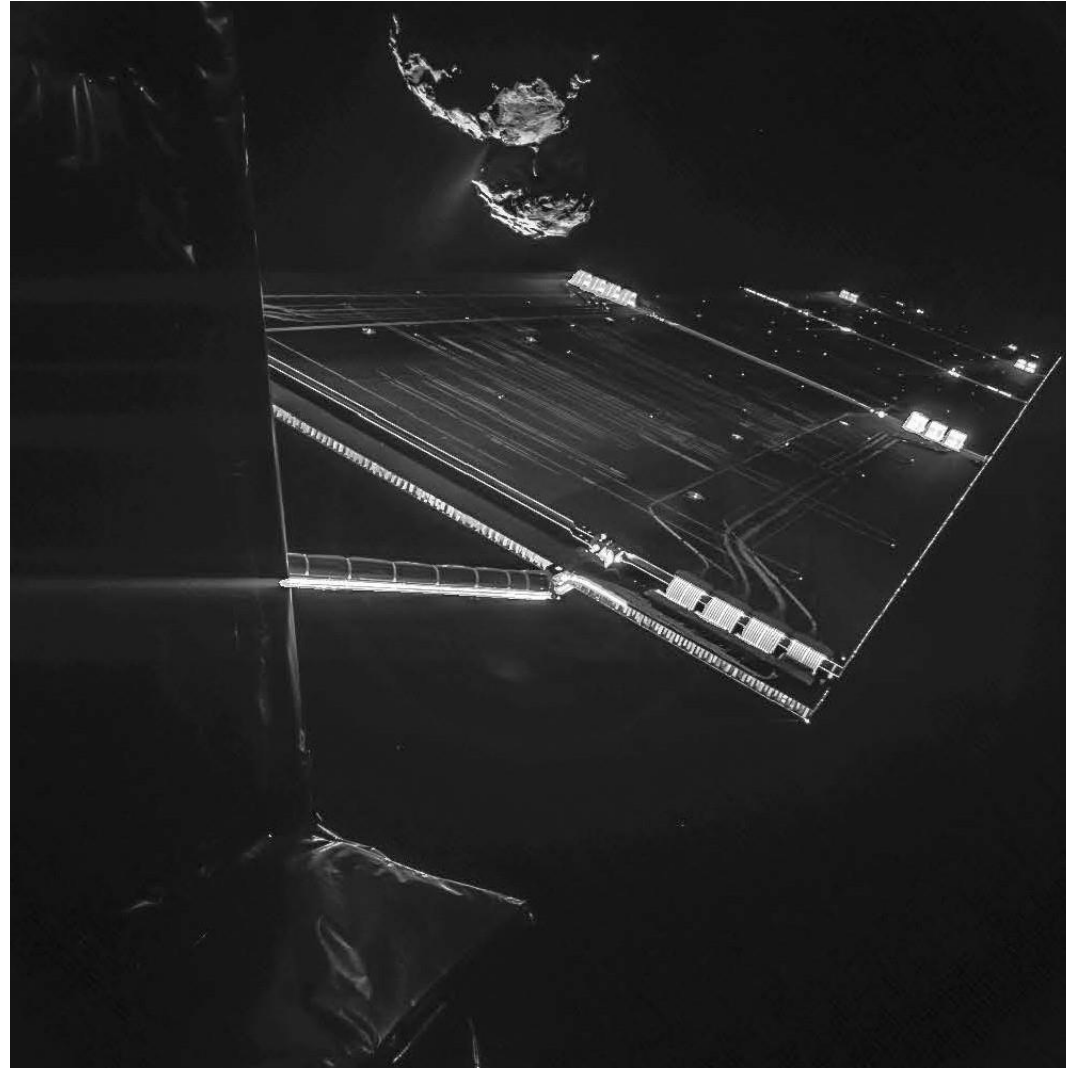
Cassini-Huygens Spacecraft to Saturn



Paris Metro Automated Subway



Rosetta Spacecraft to Comet 67/P

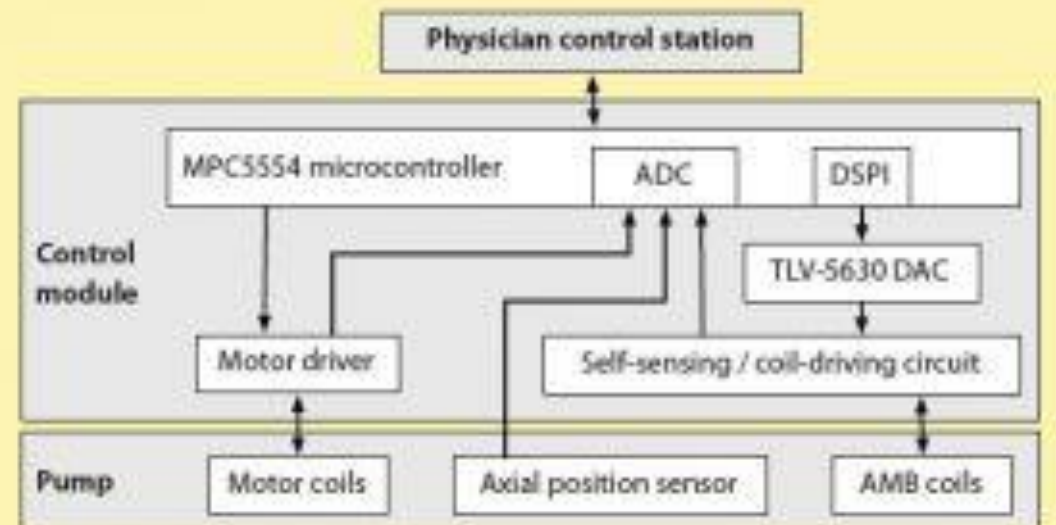
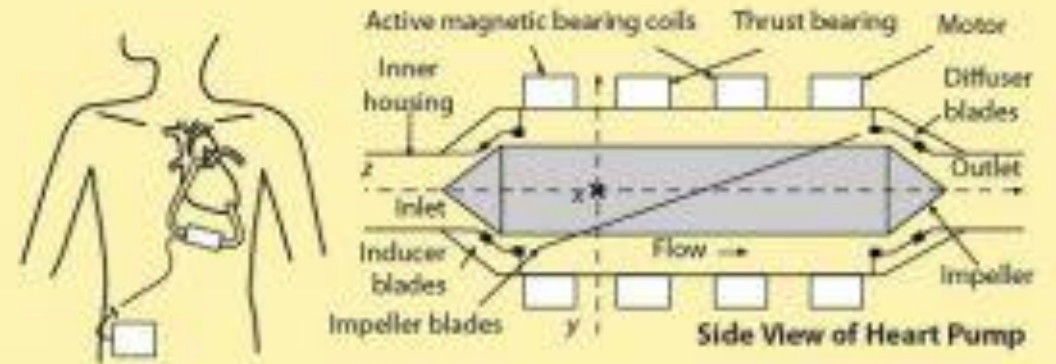


SPARK

- SPARK is a dialect of Ada with an associated toolset
 - Strengthens Ada's robustness by adding *mathematical proofs of correctness*
- A study showed...
 - Ada code had about 10% the fault rate (bug rate) of C code
 - SPARK code had about 10% the fault rate of Ada code
 - Thus SPARK is about 100 times more reliable than C in this sense
- We will also introduce SPARK later in this class

LifeFlow Ventricular Assist Device

- Magnetically levitated rotors spin at 8000 rpm less than 0.1 mm from the pump cavity walls
- Less damage to red blood cells
- Requires software control
- Consider what happens as patient moves!
- University of Virginia research project using SPARK



Toyota “Unintended Acceleration”

- Software errors in the throttle control of certain Toyota models
 - ... caused the vehicles to accelerate out of control
 - Their embedded software (in C) was found to be of terrible quality
 - Their software development process was found to be just as bad
 - Toyota apparently tried to hide these facts from investigators
- Result: *Fined \$1,200,000,000.00!*
- Toyota subsequently announced research project to look into the possibility of using SPARK
 - <http://www.adacore.com/customers/toyota-itc-japan/>

Will You Work for Toyota?

- Companies engaged in safety critical development may turn to Ada
 - Toyota is considering it
 - One imagines the other auto manufacturers are looking into it
 - AdaCore is also interested in engaging the medical device community
- Security concerns are also significant
 - NVIDIA is using SPARK on some of their graphics cards for security reasons
- There are legions of Java programmers graduating from colleges
 - ... but very few Ada/SPARK programmers because, of course, nobody uses Ada