

Leadership in Space: Unique Economic, National Security and Quality of Life Benefits

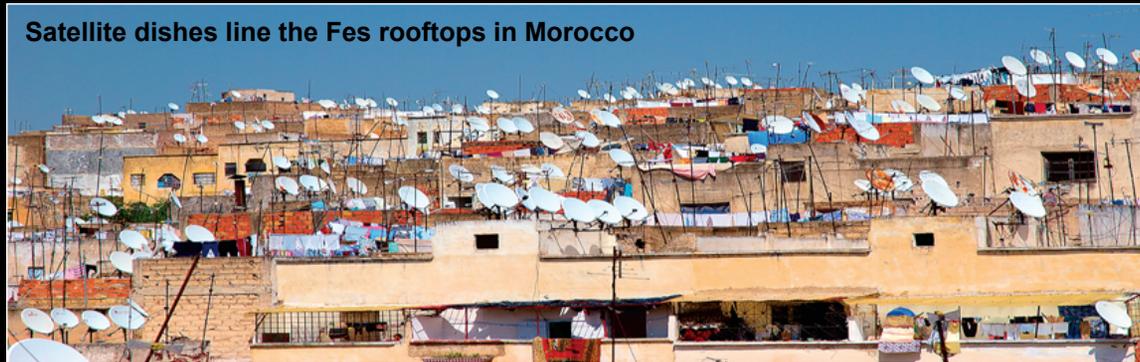
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The Space Economy

- Investments in space are about improving and protecting life on Earth.
- Today, we rely on space assets for a wide range of communications, navigation, reconnaissance, and planning outcomes that affect applications as diverse as agriculture, disaster relief and defense operations.
- The outlook for space markets is strong
 - USAF, NASA and NOAA plans have increased emphasis on space in future years.
 - U.S. commercial space interests are rapidly accelerating
 - Worldwide, the utilization of space is of interest

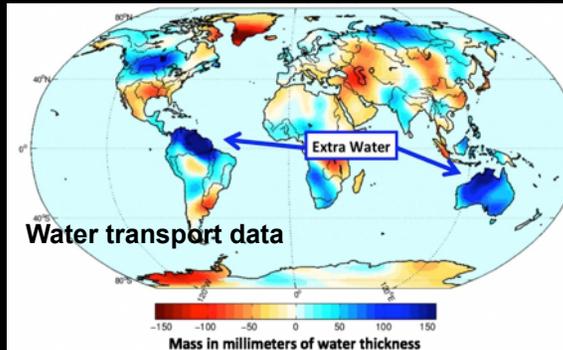
Satellite dishes line the Fes rooftops in Morocco



Hurricane Sandy data



Water transport data



Damascus, Syria, July 18, 2012



Some of the Space Products That Have Improved Our Lives



Advanced Diagnostic Ultrasound in Microgravity



LED Light Therapy For Pain Management



Groundwater Remediation



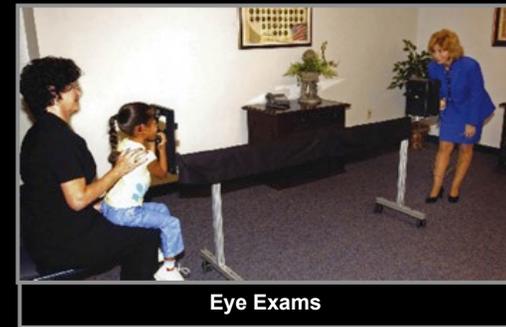
Clean Energy



Lithium Batteries for Cars



Aerogel Insulation



Eye Exams



Memory Foam



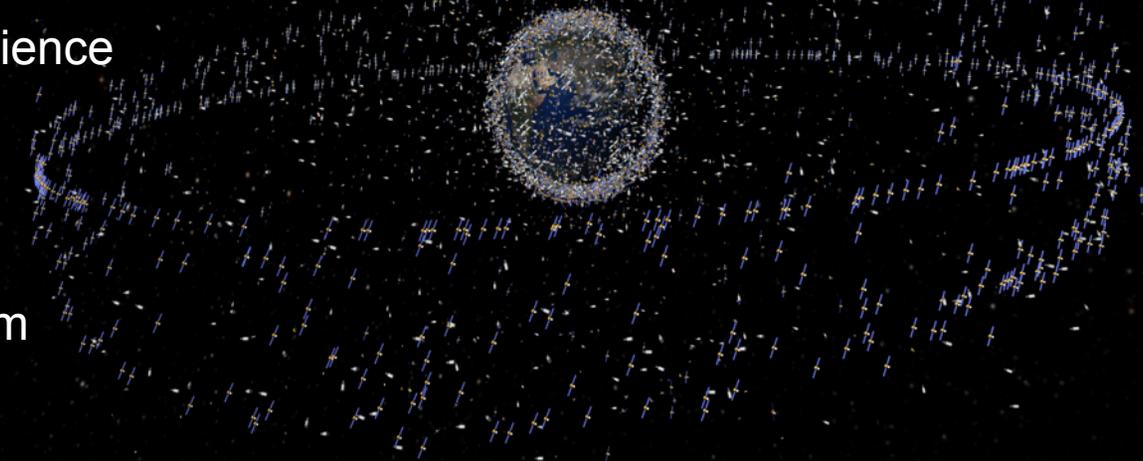
Nutritional Supplements



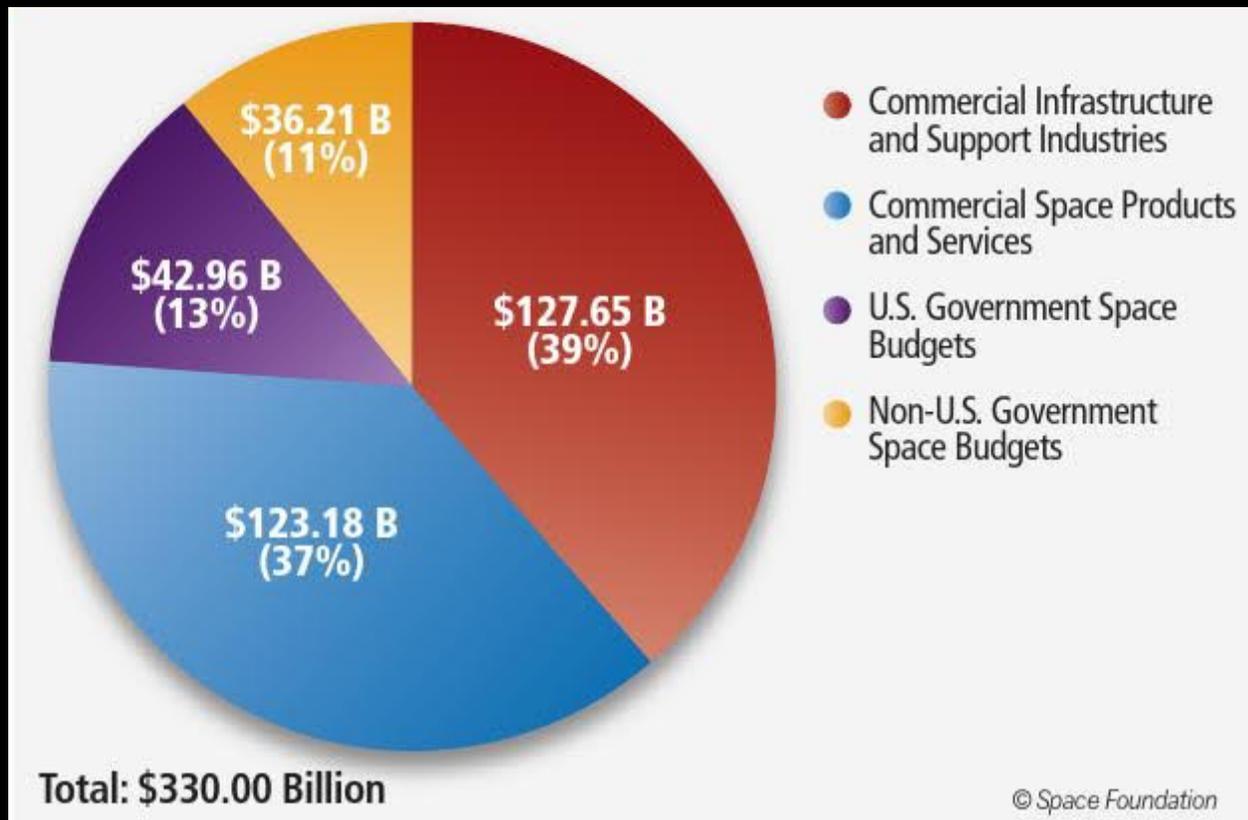
Infrared Thermometers

A Turning Point for Space Commerce

- The Space Age is 50 years young and in transition
 - Military and civil space applications are poised for growth
 - 2011 Shuttle retirement provided significant impetus for growth of the commercial spaceflight industry
 - Today's civilian focus
 - Services
 - Earth and planetary science
 - Human presence
 - Resources
 - Today's military focus
 - Reconnaissance/Comm
 - Responsiveness
 - High-ground
 - Planetary defense



Space Market: \$330B



- U.S. government spends more on space than all other govts combined
- Private sector dominates space economy (76%)
- Space is becoming commercial services dominated sector (presently 37%)

The Space Sector is a Major Driver of U.S. Economic Competitiveness

- Per Aerospace Industries Association in 2015:
 - Over 600,000 U.S. jobs in aerospace. Of these, about 70,000 are spacecraft/missile jobs and another 124,000 sensor jobs
 - Average annual earning of these space-oriented jobs is \$99-108k
 - Aerospace provided U.S. a \$67B positive trade balance, the largest positive component to our economy.
 - For reference, agriculture provided ~\$20B in 2015 and ~\$40B/yr in 2012-14



Georgia Strengths

- Strong and established aeronautics industry
- The largest aerospace engineering research and education program in the world (Georgia Tech School of Aerospace Engineering)
 - More than 1200 students and 40+ faculty
 - Ranked #2 in the nation in both undergraduate and graduate programs
 - GT also houses significant space research programs across campus in the Schools of AE, ME, ECE, EAS, Physics, Chemistry, and GTRI
- Strong military community
- Talented, dedicated, low-cost workforce; manufacturing skills
- National logistics/transportation center
- Low-cost land and large coastline
- “Capital” of the south. Human spaceflight has a strong southern ties around us (Mississippi, Alabama, Louisiana, Texas and Florida)
- Potential spaceport in Camden County
- Increasing number of GA space entrepreneurs

One Example

THE FUTURE IS SMALL

GEORGIA TECH RESEARCHERS ARE DEVELOPING
SMALL SATELLITES AND ADVANCED TECHNOLOGY FOR
THE NEXT GENERATION OF **SPACE EXPLORATION**

BY JOHN TOON
PHOTOS BY ROB FELT



PROX-1 will be Georgia Tech's first complete spacecraft, a fully-functioning vehicle that will demonstrate automated trajectory control of one spacecraft relative to another.

For three decades, the symbol of the U.S. space program was the mighty Space Shuttle, an 86-ton reusable spacecraft that hauled astronauts, equipment, and supplies into orbit 135 times before being retired in 2011.

Among candidates for the next symbol might be the shiny aluminum box located on a clean room assembly bench in Georgia Tech's Engineering Science & Mechanics (ES&M) building. Made of space-grade metal, the 50 x 50 x 30 centimeter structure is rapidly being transformed into Prox-1, a micro satellite that will itself become a launcher for an even smaller satellite known as LightSail-B. Next fall, the two spacecraft will orbit the Earth together to study automated trajectory control required for close proximity flying in space.

Beyond studying control issues, Prox-1 will help its mostly student crew learn how to design, build, launch, and operate spacecraft. The 60-kilogram satellite will also be Georgia Tech's first entry into the era of small spacecraft — a phenomenon made possible by the same miniaturization and capability enhancements that put smartphones into nearly everyone's pockets.

And LightSail-B, designed and built by the Planetary Society, will highlight the role of CubeSats — tiny satellites just 10 centimeters square that can be constructed for as little as \$20,000 apiece. These spacecraft, built in a standardized template to hitch rides on larger space vehicles, are giving universities and other organizations the kind of space access once reserved for NASA, the Department of Defense, and big corporations.

"Where we once talked about mammoth spacecraft that took decades and billions of dollars to build, we are now talking about breaking complex space objectives into smaller chunks," said Robert Brunton, a professor in Georgia Tech's Daniel Guggenheim School of Aerospace Engineering and director of its Center for Space Technology and Research (C-STAR). "Working together, a dozen smaller spacecraft might accomplish that big objective at a fraction of the cost. These small spacecraft might be the size of a trash can or a night table, and they'll be developed much more quickly, providing opportunities to utilize the latest technology."

In all, Georgia Tech researchers expect to launch six small satellites into Earth orbit over the next five years. Beyond that, they're thinking about planetary exploration, and are helping design the instruments aboard spacecraft that may visit Europa, a moon of Jupiter whose ocean may harbor life. Other researchers are looking toward Mars, with the idea that tiny spacecraft could hitch a ride on larger probes to explore that planet or its moons.

But designing and building small spacecraft and their instruments isn't the whole story of Georgia Tech's growing presence in space. Researchers are also improving the electric propulsion systems that will power both large and small spacecraft — and perhaps even help haul supplies to Mars. And in early 2016 on the International Space Station, they expect to begin testing what may be a future generation of photovoltaic cells to provide space power.

CUBESAT LAUNCHER AND TRACKER
In June, Bill Nye — better known as the "Science Guy" — told reporters what was happening in space aboard LightSail-A, a tiny craft that was unfurling a 32-square-meter Mylar sail designed to test the ability to move a spacecraft by capturing photons from the sun. Nye is CEO of the Planetary Society, which designed the CubeSat mission.

At about the same time, in a wood-beamed control room in the ES&M building, Dave Spencer and a group of Georgia Tech students were tracking LightSail-A — and cheering when a photograph confirmed the sail's opening. The Georgia Tech role in LightSail-A encompassed mission planning, satellite tracking, and mission operations, Spencer and the student team

Strategy for Growth

- Build public understanding of importance of space sector to GA, and industry understanding of importance of GA to space sector
 - High-quality jobs; economic benefits; national security
- Continue to grow space systems at Georgia Tech and across Georgia's university system
- Make Camden County spaceport real
- Build a GA space industry
- Consider building an alliance with Alabama and/or Florida

Benefits

- Build our Nation's Economic Competitiveness
- Contribute to our Nation's National Security Needs
- Prepare our Citizens for a Technological Future
- Inspire Youth into STEM Educational and Career Paths
- Make a Difference in Our Lives Everyday

