



Master of Science in *Aeronautical Engineering.*

Mike Gruntman

USC Aeronautics – MS ASTE
November 2021

Agenda



Statue of Neil Armstrong
on USC campus.
Sculptor: Jon Hair.

- USC and Viterbi School of Engineering
- Department of Aeronautical Engineering
- Faculty
- Research Areas, Collaborations
- Degree: *Master of Science in Aeronautical Engineering*
- Students
- Coursework
- Criteria for MS Applicants
- Contact info

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About the program

article in *Acta Aeronautica*, 2014

<http://aeronauticsnow.com/2014aste.pdf>

University of Southern California (USC)



near downtown
Los Angeles
California

- Oldest private university in western U.S. – founded in 1880
- 44,000 students: 19,000 undergraduates; 25,000 graduates
- 4,200 full-time faculty
- Draws students from all 50 states and more than 100 countries internationally



Viterbi School of Engineering (VSOE), USC



- One of the nation's leading engineering institutions in numerous disciplines: 8 academic departments, including *astronautics*
- Performs forefront research in a full spectrum of engineering disciplines (over \$180 million annually in external research funding)
- State-of-the-art laboratories, classrooms, and live interactive high-speed internet broadcast systems are available to our students.
- 2700 undergraduate and 5,600 graduate students
- Networking power of 65,000+ engineering alumni



Department of Astronautical Engineering

- Unique pure-space-engineering department (established in 2004)
- Built upon astronautical specialization, started in 1995
- Full set of degrees in **Astronautical Engineering (ASTE)**
 - ❑ Bachelor of Science (BS)
 - ❑ Bachelor of Science Minor
 - ❑ Master of Science (MS)
 - ❑ Engineer
 - ❑ PhD
 - ❑ Graduate Certificate

Mission:
to provide forefront research and education in astronautical (space) engineering

- Among largest national programs in space engineering on Master's level

About the program – articles 2018, 2014, 2007 (combined) <http://astronauticsnow.com/aste.pdf>



ASTE Core Faculty (alphabetically)



Research Prof. David Barnhart
Director, Space Engineering Research Center (SERC)

Prof. Daniel A. Erwin, Chair (also Chair 2007-2016)
Director, Bachelor of Science (BS ASTE)



Prof. Mike Gruntman (also Chair 2004-2007, 2016-2019)
Director, Master of Science (MS ASTE)

Prof. Joseph A. Kunc emeritus



Prof. Azad M. Madni
Director, Systems Architecting and Engineering (SAE)



Prof. Joseph Wang
Director, ASTE PhD Program

Prof. of Practice Garrett Reisman



ASTE: Faculty and Staff



ASTE Staff

Dell Cuason
ASTE Business Manager



Linda Ly
ASTE Budget Specialist



Luis Saballos
ASTE Student Services Assistant Director



Marlyn Lat
ASTE Admin Support



Department of Astronautical Engineering Faculty, Adjunct Faculty, and Lecturers



6 full-time faculty

> 20 adjunct faculty and part-time lecturers

teach primarily graduate (Master program) courses

work full time: top specialists in leading space companies and government centers:

Boeing
NASA-JPL (Jet Propulsion Lab)
The Aerospace Corp.
Aerojet Rocketdyne
Microcosm
others ...

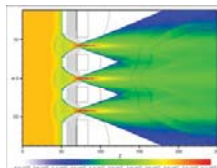


Books by faculty and instructors

Adjunct Faculty and Lecturers (grad courses)

- Dr. Mohamed Abid (JPL)
- Dr. Oscar Alvarez-Salazar (JPL)
- Dr. Rodney Anderson (JPL)
- Dr. Lubos Brieda (Particle-in-Cell)
- Prof. Don Edberg (Cal Poly Pomona)
- Dr. Anthony Freeman (JPL)
- Dr. Keith Goodfellow (Aerojet Rocketdyne)
- Dr. Troy Goodson (JPL)
- Prof. Gerald Hintz (ret. JPL, Aerospace Corp.)
- Prof. Michael Kezirian (IAASS, ISSF)
- Mr. Steve Matousek (JPL)
- Dr. Leila Meshkat (JPL)
- Prof. Ryan Park (JPL)
- Dr. Robert Parker (ret. Northrop-Grumman)
- Dr. G.P. Purohit (Aerospace Corp.)
- Dr. David Reese (Aerospace Corp.)
- Prof. Anita Sengupta (Hyperloop)
- Mr. Madhu Thangavelu (AAA Visioneering)
- Prof. Kent Tobiska (Space Environm. Techn.)
- Prof. James Wertz (Microcosm)
- Dr. Bret Williams (Facebook; fmr. Boeing)

Department of Astronautical Engineering Research Areas



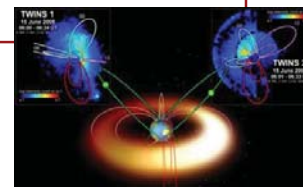
- Astronautics
- Space environment and spacecraft interactions
- Space science
- Space instrumentation and sensors
- Spacecraft propulsion
- Space mission and spacecraft design
- Non-equilibrium processes in gases and plasmas
- Computational physics and high performance computing

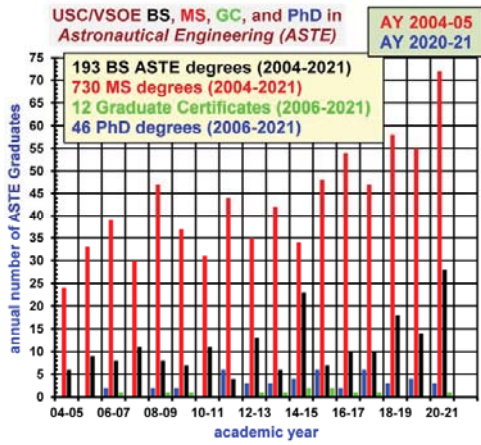


- Faculty are Principal Investigators (PI's) and Co-Investigators (Co-I's) on programs supported by NASA, Air Force, Navy, NSF, industry
- Served on science teams (members, investigators, development, analysis): *Pioneer 10/11*, *SOHO*, *Deep Space 1*, *IMAGE*, *Dawn*
- Current NASA missions Co-I: *TWINS* and *IBEX*

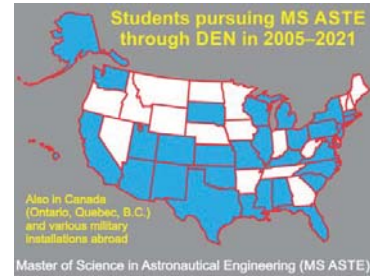
• Student (undergraduate and Master's) projects

- Rocket propulsion lab
- Liquid-propulsion lab
- Lunar lander
- Student microsatellites and cubesats

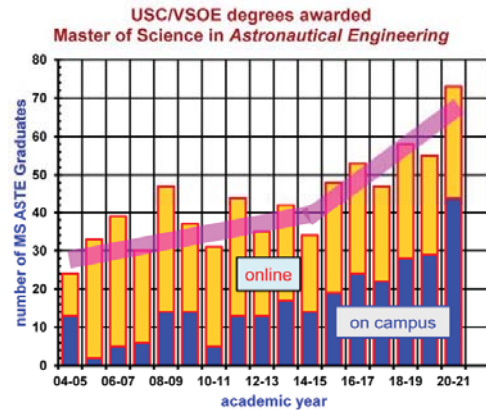




Statistics



Distance Education Network DEN@Viterbi



730 MS ASTE degrees awarded from 2004-2021

3.0-3.5% nationally awarded Master's degrees in astronautical/aeronautical/aerospace engineering
~70 aerospace-related departments and programs in the United States

Master of Science Program in Astronautical Engineering



- Degree in the highly dynamic and technologically advanced area of astronautics and space technology
- Program designed for those with **B.S. degrees in science and engineering** who work or wish to work in the space sector of the space/defense/aerospace industry, government space research and development centers and laboratories, space operations, and academia
- Combines science and engineering fundamentals with specialized courses
- VSOE **Astronautics faculty** and **adjunct faculty and lecturers from leading space companies and government space R&D centers** (Boeing, Lockheed-Martin, Northrop-Grumman, Aerospace Corporation, NASA Jet Propulsion Laboratory, Raytheon, Aerojet Rocketdyne, Microcosm, Space Environment Technologies, ...)

National reach through
*Distance Education
Network (DEN@Viterbi)*

international
possible

Master of Science Program in *Astronautical Engineering* – Students –



- Students pursuing MS in Astronautical Engineering
 - ❑ Full-time on-campus students – 50% awarded degrees
 - ❑ Working full-time and studying part-time students (through **Distance Education Network of the Viterbi School – DEN@Viterbi**) – 50%
 - ❑ Active duty military (Air Force, Army, Navy, Marine Corp)
 - ❑ Student background (BS and MS degrees)
 - Astronautical engineering
 - Mechanical Engineering
 - Electrical engineering
 - Aerospace engineering
 - Other engineering areas (chemical, computer, systems, ...)
 - Physics and Astronomy
 - Other areas of science (including medical doctors)
 - Planning apply for astronaut training
 - Pathway to positions in system engineering of space systems (especially important for engineers with BS and MS in EE, ME, etc.)

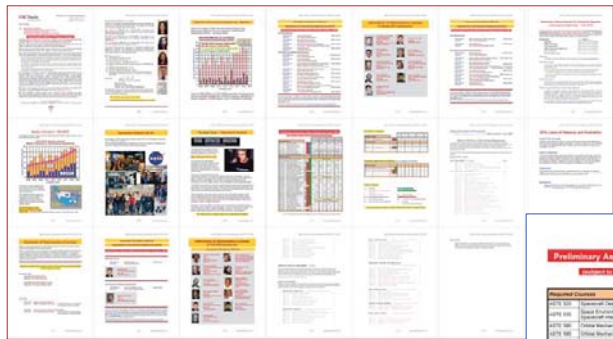
**USC
Astronautics**

LinkedIn group
USC Astronautics
launched in April 2009
> 650 members

http://astronauticsnow.com/astrousc_linkedin/




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MS ASTE Newsletter

Newsletter URL
http://astronauticsnow.com/msaste/astd_ms-aste_update.pdf

Program news and
schedule of classes

Master of Science in Astronautical Engineering, VITERBI/CEE, April 2020

Preliminary Astronautics Class Schedule (as of Apr 2020)

Students to change or update a class on this schedule

Course	2019	2020	2021	2022	2023	2024	2025
ASTE 501 - Introduction to Astronautics							
ASTE 502 - Spacecraft Design							
ASTE 503 - Spacecraft Navigation							
ASTE 504 - Spacecraft Control							
ASTE 505 - Spacecraft Structures							
ASTE 506 - Spacecraft Propulsion							
ASTE 507 - Spacecraft Power Systems							
ASTE 508 - Spacecraft Thermal Control							
ASTE 509 - Spacecraft Communications							
ASTE 510 - Spacecraft Mission Design							
ASTE 511 - Spacecraft System Integration							
ASTE 512 - Spacecraft Testing							
ASTE 513 - Spacecraft Operations							
ASTE 514 - Spacecraft Safety							
ASTE 515 - Spacecraft Reliability							
ASTE 516 - Spacecraft Maintenance							
ASTE 517 - Spacecraft Repair							
ASTE 518 - Spacecraft Decommissioning							
ASTE 519 - Spacecraft Disposal							
ASTE 520 - Spacecraft Recycling							

Master of Science in Astronautical Engineering, VITERBI/CEE, April 2020

Courses in summer

Course	2019	2020	2021	2022	2023	2024	2025
ASTE 501 - Introduction to Astronautics							
ASTE 502 - Spacecraft Design							
ASTE 503 - Spacecraft Navigation							
ASTE 504 - Spacecraft Control							
ASTE 505 - Spacecraft Structures							
ASTE 506 - Spacecraft Propulsion							
ASTE 507 - Spacecraft Power Systems							
ASTE 508 - Spacecraft Thermal Control							
ASTE 509 - Spacecraft Communications							
ASTE 510 - Spacecraft Mission Design							
ASTE 511 - Spacecraft System Integration							
ASTE 512 - Spacecraft Testing							
ASTE 513 - Spacecraft Operations							
ASTE 514 - Spacecraft Safety							
ASTE 515 - Spacecraft Reliability							
ASTE 516 - Spacecraft Maintenance							
ASTE 517 - Spacecraft Repair							
ASTE 518 - Spacecraft Decommissioning							
ASTE 519 - Spacecraft Disposal							
ASTE 520 - Spacecraft Recycling							

Courses listed but not offered (due to availability of instructors)

Course	2019	2020	2021	2022	2023	2024	2025
ASTE 501 - Introduction to Astronautics							
ASTE 502 - Spacecraft Design							
ASTE 503 - Spacecraft Navigation							
ASTE 504 - Spacecraft Control							
ASTE 505 - Spacecraft Structures							
ASTE 506 - Spacecraft Propulsion							
ASTE 507 - Spacecraft Power Systems							
ASTE 508 - Spacecraft Thermal Control							
ASTE 509 - Spacecraft Communications							
ASTE 510 - Spacecraft Mission Design							
ASTE 511 - Spacecraft System Integration							
ASTE 512 - Spacecraft Testing							
ASTE 513 - Spacecraft Operations							
ASTE 514 - Spacecraft Safety							
ASTE 515 - Spacecraft Reliability							
ASTE 516 - Spacecraft Maintenance							
ASTE 517 - Spacecraft Repair							
ASTE 518 - Spacecraft Decommissioning							
ASTE 519 - Spacecraft Disposal							
ASTE 520 - Spacecraft Recycling							

Table notation

■ = approved
■ = course offered in both fall and spring semesters
■ = course offered both years
■ = course offered every second year
■ = course offered irregularly
■ = approved by faculty approval
■ = approved by USC Student Advisor
■ = not offered
■ = on campus, not available through DEN
■ = approved by USC Student Advisor

The course schedule is subject to change. Please check with USC Student Advisor.

Schedule of classes URL
http://astronauticsnow.com/msaste/astd_ms_class_schedule.pdf


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Master of Science Program in *Astronautical Engineering* – Coursework –



Master of Science in Astronautical Engineering coursework requirement:
total of 27 units or 9 courses (one course is usually 3 units)

- ❑ **4 required astronautics courses**
 - Spacecraft Systems Design
 - Space Environment and Spacecraft Interactions
 - Spacecraft Propulsion
 - Orbital Mechanics
- ❑ **3 core elective courses** from the list of astronautics core courses
- ❑ **2 technical elective courses** selected from courses in astronautical engineering and/or from other science/engineering graduate courses
 - MS Program in Astronautical Engineering never limits choice of technical elective courses to those offered by the home department but rather encourages students to choose engineering and science graduate courses best meeting their educational objectives
- ❑ MS Thesis is optional (possible but not required)

MS ASTE: Astronautics Coursework



Continuously developing and
introducing new coursework

leading specialists in space industry teach
most specialized courses (part-time lecturers)

- Spacecraft System Design
- Space Environment and Spacecraft Interactions
- Design of Low Cost Space Missions
- Space Studio Architecting
- Entry and Landing Systems
- Orbital Mechanics I, II
- Space Navigation
- Solar System Navigation
- Spacecraft Attitude Dynamics
- Spacecraft Attitude Control
- Spacecraft Propulsion
- Liquid Rocket Propulsion
- Solid Rocket Propulsion
- Advanced Spacecraft Propulsion
- Space Launch Vehicle Design
- Physical Gas Dynamics I, II
- Spacecraft Structural Dynamics
- Spacecraft Structural Strength&Mats

- Spacecraft Thermal Control
- Spacecraft Power Systems
- Systems for Remote Sensing from Space
- Spacecraft Sensors
- Spacecraft Cryogenic Systems
- Safety of Space Systems and Missions
- Reliability of Space Systems
- Safety of Space Operations
- Human Spaceflight
- Human Factors in Spacecraft Operations
- Spacecraft Life Support Systems
- Plasma Dynamics I, II
- Computational Plasma Dynamics

recent
growth
areas

Master of Science Program in *Astronautical Engineering* – Criteria for Applicants –



- Candidates for formal admission to the Master of Science in Astronautical Engineering program require:
 - Bachelor of Science degree in engineering or science from a regionally-accredited institution ([no Bachelor's aerospace degree required](#))
 - Minimum cumulative grade point average [GPA] of **3.2** on a 4.0 scale
 - General portion of the Graduate Record Examination [GRE]
 - Two letters of recommendation
- Department application deadlines: [check with ASTE Student Services](#)
[1 June](#) for fall; [1 November](#) for spring; [1 March](#) for summer – [check with Student Advisor!](#)
- It is possible to begin studies prior to formal admission to the program as a **limited student**. You need to apply to Distance Education Network (DEN@Viterbi) for enrollment as a limited student. After your limited-student application is processed, DEN will allow you to enroll in the classes.
- Conditional admission

Master of Science Program in *Astronautical Engineering* – Common Questions –



- Typical time to complete the program
 - Full-time students: 1.5 years (3 semesters)
 - Part-time student: 3 – 4 years (1 – 2 courses per semester)
- Course sequence (e.g., required courses before electives?)
 - Course sequence is entirely up to students. Advisors help as needed. Few exceptions: space navigation requires orbital mechanics; advanced propulsion requires propulsion, ...
- Waiver of required courses – yes
 - Required courses waived if a student had similar level courses elsewhere.
- Technical electives from other departments – yes
 - Almost any graduate science and engineering course approved
- System engineering
 - Pathway to system engineering of space systems, especially for engineers with BS and MS in EE and ME
- Attending classes on campus by distance students – welcome!
- Difference between programs in *Astronautical* and *Aerospace* Engineering
 - see: <http://astronauticsnow.com/2014aste.pdf>
- Industry interest
 - Enrollment dynamics proves that the program meets the real demand of the industry/gov't

Master of Science Program in *Astronautical Engineering* Contact Information



Department of Astronautical Engineering (ASTE)

ASTE Administrator
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MS ASTE Program Director
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tel. 213-740-5536

Frequently Asked Questions
<http://astronauticsnow.com/msaste/faq.html>



About the program
article in *Acta Astronautica*, 2014
<http://astronauticsnow.com/2014aste.pdf>

It is the time to enroll to
school for your
**advanced degree in
*Astronautical
Engineering.***

USC/VSOE Distance
Education Network will
reach you anywhere in
the known Universe.

Ad
Astra!

