Discover Viterbi: Astronautical Engineering with Professor Mike Gruntman

Viterbi School of Engineering
University of Southern California
Fall 2017
WebEx Quick Facts

Will I be able to get a copy of the slides after the presentation?

YES!

How can I ask a question during the information session?

1. Using the Q&A Panel, type a question in the box below the Ask drop-down menu.
2. Select a recipient from the Ask drop-down menu.
3. Click Send. We will respond as soon as we are able.
Today’s Program

- University of Southern California
- USC Viterbi School of Engineering
- DEN@Viterbi
  - Enrollment Options
  - Tuition & Fees
- Master of Science in Astronautical Engineering
  - Department & Program Overview
  - Application Criteria
- Q&A
The University of Southern California

- Oldest Private University in the western U.S.
  - Founded in 1880
- 44,000 Students
  - 19,000 Undergraduates | 25,000 Graduates
- 4,190 Full-time Faculty
- Diverse Student Population
- Located in Los Angeles
Viterbi School at a Glance

Academic Departments
- 8 Academic Departments

Faculty
- 185 tenure-track faculty
- 20+ members of the National Academy of Engineering
- 60+ NSF CAREER, National & Presidential Young Investigator

Student Populations
- 2,700 Undergraduate
- 5,600 Graduate students

Research
- Leader in funded research
- 45+ Research Centers
- More than $185M in annual research expenditures

Alumni
- More than 65,000+
U.S. News & World Report, 2017

Best Engineering Graduate Schools

- **Top Ranked Graduate Engineering Program**

Best Online Graduate Engineering Programs

- **Ranked #1 Online Graduate Engineering Programs**
- **Ranked #1 Online Computer Information Technology Program (Computer Science)**

Best Online Graduate Engineering Programs for Veterans

- **Ranked #1 Online Graduate Engineering for Veterans**
- **Ranked #1 Online Computer Information Technology for Veterans**

USC Viterbi
School of Engineering
USC Engineering: Points of Distinction

- International Reputation for Excellence
- The Trojan Family Network: 65,000+ engineers strong
- Unique engineering programs available: Online, on site & on campus
- Complete range of programs
  - PhD, Masters and Bachelors
  - Graduate Certificates
  - Short Courses
  - Custom Programs
The Viterbi School of Engineering: A Leader in Research

Viterbi School is a consistent leader in funded research in the U.S.

- Highly interdisciplinary research environment
- Diverse research areas as robotics, software engineering, sensor networks, vision sciences, automated construction and photonics
- Over 45 research centers
- Industrial partnerships and collaboration
Course Delivery Methods

Methods of Course Delivery

• On-campus, full time
  3 classes per semester
  1.5 – 2 years to complete

• Online delivery via DEN@Viterbi
  1-2 classes per semester
  2.5 – 3 years to complete degree
How DEN@Viterbi Works

The Viterbi School of Engineering uses a state-of-the-art, proprietary web-based delivery system that enables students from around the world to access classes live or on-demand.

DEN@Viterbi Students:

- View the same lectures as on-campus students, with fresh content every semester
- Participate in highly interactive discussions with professors and peers
- Submit homework electronically
- Take exams at proctored testing centers near their home or work (or at USC if in the Los Angeles area)
## DEN@Viterbi Overview

<table>
<thead>
<tr>
<th></th>
<th>DEN@Viterbi Student</th>
<th>On-Campus Student</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Admission</strong></td>
<td>USC Graduate Application &amp; required materials</td>
<td>USC Graduate Application &amp; required materials</td>
</tr>
<tr>
<td><strong>Weekly Course Lectures</strong></td>
<td>Online with Interactivity</td>
<td>On USC’s Campus</td>
</tr>
<tr>
<td><strong>Online Course Archives (Lectures &amp; Course Documents)</strong></td>
<td>✓</td>
<td>✓ *</td>
</tr>
<tr>
<td><strong>Assignments</strong></td>
<td>Submit electronically according to course deadlines</td>
<td>Submit during lecture or lab according to course deadlines</td>
</tr>
<tr>
<td><strong>Exams</strong></td>
<td>Proctored location</td>
<td>USC’s campus</td>
</tr>
<tr>
<td><strong>Courses per Semester (Average)</strong></td>
<td>1-2</td>
<td>3-4</td>
</tr>
<tr>
<td><strong>Degree Completion Requirements</strong></td>
<td>27-37 units with a 3.0 GPA or above</td>
<td>27-37 units with a 3.0 GPA or above</td>
</tr>
<tr>
<td><strong>USC Diploma (No Distinction)</strong></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

*DEN@Viterbi Sections Only
DEN@Viterbi’s E-Learning System

DEN@Viterbi Classroom
DEN@Viterbi’s E-Learning System
DEN@Viterbi’s E-Learning System

Helium Porosity vs. Air Permeability

- Used to select porosity cut-offs, for reservoir rocks.
- Based on permeability values.

dgh@bellpetro.com

PTE-461: Fall 2017 Section 3: Petrophysics  Slide No.: 23
DEN@Viterbi Additional Info

- **Limited Status**
  - Allows strong candidates to begin coursework before formal admission.
  - Courses (maximum of 12 units) can be applied toward degree program once admitted but *limited status does not guarantee admission*.
  - Get Started: https://viterbigradadmission.usc.edu/denviterbi/getting-started/

- **Tuition Deferment Program**
  - Students supported by company can defer “up front” payment of tuition until after the semester is over.
  - Company must pay 75-100% of tuition to be eligible for program.
  - For additional information: https://viterbigrad.usc.edu/tuition-and-funding/employer-supported
# Tuition & Fees (2017-2018)

## Example of tuition and fees for a DEN@Viterbi Student

<table>
<thead>
<tr>
<th>PER-COURSE FEES</th>
<th>Unit Cost</th>
<th>Tuition for 3-Unit Course</th>
<th>Tuition for 4-Unit Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuition for 500/600 level course</td>
<td>$1,937</td>
<td>$5,811</td>
<td>$7,748</td>
</tr>
</tbody>
</table>

Degree Programs are 27-36 units (9-11 courses)

For an overview of additional fees, please visit: [https://viterbigradadmission.usc.edu/programs/masters/ tuition-funding/tuition-funding-masters/](https://viterbigradadmission.usc.edu/programs/masters/tuition-funding/tuition-funding-masters/)
General Application Deadlines

Application Deadlines for 2018

Fall 2018
- Deadline to submit all required materials: January 17, 2018*
- Deadline for Scholarship Consideration (on-campus only): December 15, 2017

Spring 2019
- Deadline to submit all required materials: September 15, 2018*
- Deadline for Scholarship Consideration (on-campus only): August 31, 2018

* A deadline extension for DEN@Viterbi applicants may be available. Please email DEN@Viterbi.usc.edu for more information.

Helpful Links:
List of DEN@Viterbi Programs
http://viterbi.usc.edu/DENDegrees
USC Graduate Application:
https://usc.liaisoncas.com
Getting Started

For those interested in taking classes on campus:

- Visit USC campus
- Start your application: http://www.usc.edu/admission/graduate/apply

For those interested in taking classes online via DEN@Viterbi:

- Start as a Limited Status Student in Spring 2018 –or-
- Start your application: http://www.usc.edu/admission/graduate/apply
Meet Professor Mike Gruntman

- Chairman of Astronautical Department
- Professor of Astronautical Engineering
- Research in Astronautics, spacecraft and space mission design, space physics, space instrumentation and sensors, space plasmas, spacecraft technologies, rocketry, propulsion, orbital debris.
- Authored and co-authored nearly 300 scholarly publications, including 4 books.
Master of Science in Astronautical Engineering

Mike Gruntman
Department Chair, Astronautical Engineering

Program Director
Master of Science in Astronautical Engineering

November 7, 2017
Agenda

- Department of Astronautical Engineering
- Faculty
- Research Areas, Collaborations
- Degree: Master of Science in Astronautical Engineering
- Students
- Coursework
- Criteria for MS Applicants
- Contact info

About the program – article in Acta Astronautica, 2014
MS ASTE at your fingertips

Mike Gruntman
mikeg@usc.edu
Dept. of Astronautical Engineering, VSOE
Department of Astronautical Engineering

- Established as Astronautics and Space Technology Division in 2004 “to take full advantage of growing opportunities in space”
  - founding Chairman (2004–2007) Prof. Mike Gruntman
- Operated as an independent department from 2004
- Built upon astronautical specialization, started in 1995
- Followed standard process in building a new department in a university (degree approval, course development, ABET accreditation, student affairs, ...)
- Responsible for programs in space engineering in USC
- Established a full set of degrees, including a large nationally-prominent Master’s degree program
- *Department of Astronautical Engineering* since July 2010
Department of Astronautical Engineering

- Unique pure-space-engineering department
- Offers the full set of degrees in Astronautical Engineering (ASTE)
  - Bachelor of Science
  - Bachelor of Science Minor
  - Master of Science
  - Engineer
  - PhD
  - Graduate Certificate
- Among largest national programs in space engineering
- Mission: to provide forefront research and education in astronautical (space) engineering
Faculty, Adjunct Faculty, and Lecturers

Faculty
- Prof. Mike Gruntman (Chairman; Director, Master of Science Program)
- Prof. Daniel Erwin (Director, Bachelor of Science Program)
- Prof. Joseph A. Kunc
- Prof. Azad Madni
- Prof. Joseph Wang (Director, PhD Program)

Research Faculty
- Prof. David Barnhart
- Prof. Sergei Gimelshein
- Prof. Herb Schorr (joint appt.; ISI)
- Prof. Peter Will (joint appt.; ISI)

Adjunct Faculty and Lecturers (grad courses)
- Dr. Mohamed Abid (JPL)
- Dr. Oscar Alvarez-Salazar (JPL)
- Dr. Rodney Anderson (JPL)
- Prof. Bruce Cordell (21st Century Waves)
- 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)
- Dr. Johnny Kwok (JPL)
- 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
- Mr. Madhu Thangavelu (AAA Visioneering)
- Prof. Kent Tobiska (Space Environm. Techn.)
- Prof. James Wertz (Microcosm)
- Dr. Bret Williams (Raytheon)
- Dr. Sydney Yuan (Aerospace Corp.)
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 PI’s and Co-i’s on programs supported by NASA, Air Force, Navy, NSF, industry
- Science team member/investigator/development: Pioneer 10/11, SOHO, Deep Space 1, IMAGE, Dawn
- Current NASA missions Co-I: TWINS and IBEX

- Student (undergraduate) projects
  - Sounding rocket
  - Lunar lander
  - Student microsatellite
  - International Student Satellite
Department of Astronautical Engineering

Interdisciplinary Collaborations

Interdisciplinary collaborations with other USC departments/schools

- Electrical Engineering
- Mechanical Engineering
- Information Sciences Institute (ISI), VSOE
- Systems Architecting and Engineering
- Physics and Astronomy

External collaborations

- U.S. Universities (Harvard, UC Berkeley, U of Arizona, BU, ...)
- NASA centers (JPL, Goddard)
- DoE National Labs (Los Alamos)
- R&D centers (Applied Physics Laboratory; Southwest Research Institute, ...)
- Industry (Northrop-Grumman, Lockheed-Martin, Boeing, ...)
- Foreign R&D centers and universities (Germany, Japan, ...)
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 research and development centers and laboratories, 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, ...)

November 7, 2017
USC Astronautics

9/19
Master of Science Program in Astronautical Engineering

Students

- Students pursuing MS in Astronautical Engineering
  - Full-time on-campus students – 25-30%
  - Working full-time and studying part-time students (through Distance Education Network of the Viterbi School – DEN@Viterbi) – 70-80%
- Active duty military (Air Force, Army, Navy, Marine Corp)
- Student background (BS and MS degrees)
  - Astronautical engineering
  - Mechanical Engineering
  - Electrical engineering
  - Aerospace engineering
  - Other areas (chemical, computer, systems, etc) of engineering
  - Physics and Astronomy
  - Other areas of science (including medical doctors)
  - Planning to 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.)
Master of Science Program in Astronautical Engineering

Students

- National statistics (American Society of Engineering Education – ASEE) combines students in astronautical, aeronautical, and aerospace, engineering in one broad group (>50 departments in the United States)

- In AY 2011-2012, USC MS ASTE program accounted for 2.7% of national enrollment in this broad aerospace/astronautical/aeronautical group

Astronautics M.S. Students

National Reach (through Distance Education Network DEN@Viterbi)

- Among students working full-time and studying part-time in AY 2011-2012, USC MS ASTE program accounted for 6.6% of national enrollment of astronautical/aeronautical/aerospace students

Students pursuing MS ASTE through DEN in 2005–2016

Also in Canada (Ontario, Quebec, BC) and various military installations abroad

Master of Science in Astronautical Engineering (MS ASTE)
Master of Science Program in Astronautical Engineering

Students

>500 MS ASTE degrees awarded from 2004–2017; 39+ annually during last 12 acad. years

3.3% nationally awarded Master’s degrees in astronautical/aeronautical/aerospace engineering

USC/VSOE Master of Science in Astronautical Engineering (ASTE)

Number of MS ASTE Graduates

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>04-05</th>
<th>06-07</th>
<th>08-09</th>
<th>10-11</th>
<th>12-13</th>
<th>14-15</th>
<th>16-17</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>30</td>
<td>40</td>
<td>30</td>
<td>50</td>
</tr>
</tbody>
</table>

USCViterbi
School of Engineering

November 7, 2017
USC Astronautics
Community of Alumni, Students, and Supporters

USC Astronautics Alumni, Students, Faculty, and Friends

USC Master of Science in Astronautical Engineering: Overview (video: 53 min)
USC program Master of Science in Astronautical Engineering: update - April 21, 2011 (pdf)

Linkedin Group
USC Astronautics Alumni, Students, Faculty, and Friends

LinkedIn Group

The network of the alumni, students, faculty, and friends of the USC Astronautics, a rapidly growing program offering degrees in astronautical engineering. Hundreds of our alumni work in the leading American space companies and government research and development centers.

Welcome not only our current and former students with the degrees in Astronautical Engineering (or the old degree Aerospace Engineering, Astronautics), but also all current and former USC students who took our space classes and are part of the great space enterprise. USC Astronautics began as a space engineering specialization in the Viterbi School of Engineering of the University of Southern California. Today, it is an independent space-focused Department of Astronautical Engineering in the Viterbi School. (Astronautics program history, focus, dynamics) Please check the statistics on the number of awarded degrees (about 40 MS degrees four academic year) and program road.

In addition, we welcome to USC-Astronaut program friends, all those space professionals (industry, national labs and FFRDCs, go advocates) who are interested in and

Periodically, our group members post job offerings — many will certainly find them useful.

http://astronauticsnow.com/astrousc_linkedin/

>620 members as of 2016 and growing

November 7, 2017 USC Astronautics

13/19
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 aeronautics courses**
  - Spacecraft Systems Design
  - Space Environment and Spacecraft Interactions
  - Spacecraft Propulsion
  - Orbital Mechanics

- **3 core elective courses** from the list of aeronautics 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)**
Master of Science Program in Astronautical Engineering

Coursework

- Spacecraft System Design
- Space Environment and Spacecraft Interactions
- Orbital Mechanics I, II
- Space Navigation: Principles and Practice
- Spacecraft Attitude Dynamics
- Spacecraft Attitude Control
- Spacecraft Structural Dynamics
- Spacecraft Structural Strength and Materials
- Spacecraft Propulsion
- Liquid Rocket Propulsion
- Solid Rocket Propulsion
- Advanced Spacecraft Propulsion
- Physical Gas Dynamics I, II
- Space Launch Vehicle Design
- Design of Low Cost Space Missions
- Space Studio Architeciting
- Human Spaceflight
- Safety of Space Systems and Missions
- Entry, Descent, and Landing Systems
- Reliability of Space Systems
- Spacecraft Power Systems
- Spacecraft Thermal Control
- Systems for Remote Sensing from Space
- Spacecraft Sensors
- Space Cryogenic Systems
- Ground Comm. for Satellite Ops

➢ Continuously developing and introducing new coursework
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
  - Minimum cumulative grade point average [GPA] of 3.0 on a 4.0 scale
  - General portion of the Graduate Record Examination [GRE]
  - Two letters of recommendation

- Department application deadlines:
  - 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
  - Part-time student: 3 – 4 years (1 – 2 courses per semester)

- Course sequence (e.g., required 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

- Industry interest
  - Enrollment dynamics proves that the program meets the real demand of the industry/gov’t
Contact Us

Department of Astronautical Engineering

Department of Astronautical Engineering (ASTE)

ASTE Administrator
Ms. Dell Cuason
cuason@usc.edu
tel. 213–821–5817

Student Adviser
To be announced
tel. 213–821–4234

tel. 213–740–4488 (option 4)

Department Chair; MS ASTE Program
Director and Faculty Adviser
Prof. Mike Gruntman
mikeg@usc.edu
tel. 213–740–5536

About the program – article in Acta Astronautica, 2014

MS ASTE at your fingertips

Frequently Asked Questions
http://astronauticsnow.com/msaste/faq.html
Contact Us

USC Viterbi School of Engineering
Graduate & Professional Programs

On Campus Prospective Student Inquiries:
viterbi.gradprograms@usc.edu

DEN@Viterbi Prospective Student Inquiries:
DEN@Viterbi.usc.edu

213.740.4488

http://viterbi.usc.edu/gradprograms