

The 6th Virtual UNISEC-Global Meeting 20 February 2021

Turkish UNISEC (UTEB) Activities



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Space Systems Design and Test Laboratory

Prof.Dr. Alim Rüstem ASLAN Astronautical Engineering Department Istanbul Technical University, Turkey

- Founder/Manager, Space Systems Design and Test Laboratory
- Founder/Manager, SmallSat Communication Laboratory
- UNISEC-GLOBAL SC Member, PoC, MIC Coordinator
- IAA Corresponding Member
- IAF Correspondant
- CSO-STO AVT Panel Member
- VP, TAMSAT/AMSAT-TR, TA1ALM

Area of expertise: Design, analysis and development of pico- and nanosatellite (6 in orbit – 3 de-orbited), manned and unmanned rotorcraft systems (including prototypes), computational fluid dynamics and aerodynamics, propulsion and, defense and education technologies.





ITU, Istanbul, Turkey



by 360 Degrees by Orhan Durgut



With a history stretching back over 246years (1773), providing technical education within a modern educational environment and strong academic staff, Istanbul Technical University (İTÜ) is strongly identified with architectural and engineering education in Turkey

Department of Astronautical Engineering since 1983



UNISEC-TR History



- Started Nov 2011, by three Istanbul Universities (ITU, NDU (TurAFA), YTU)
- Over 20 participant universities
- Support of government, aerospace industry and research institutions
- 12 meetings so far hosted by starters and supporting institutions
- Working on establishing UTEB as a legal entity (to be completed soon)
- Various joint CanSat/CubeSat activities/projects
- International cooperation



UNISEC GLOBAL



History of Local Chapter Activities



Established in 2011, became Local Chapter in Nov 2014

Past activities

- Participated in CLTP in 2011, 2012, 2015 and 2017
- Participated in MIC in 2011, 2012, 2014, 2015, 2016 and 2017
- Attended All UNISEC-Global Meeting since 2013
- Organized MIC Seminars
- Participated in AIAA/APSCO/TEKNOFEST ISTANBUL CanSat
- Held CanSat Training Program/Competition since 2014
- Practical Space Projects: 6 CubeSats launched, 3 ongoing projects
- Keep it multidisciplinary, international and multi institutional





APIS LISELER ARASI MODEL UYDU VARIŞMASI

TEMMUZ 2020 İSTANBUL

> BAŞVURU İÇİN OR KODU OKUTUNUZ!

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APIS HIGH SCHOOL CANSAT COMPETITION July 2020



SIRA	TAKIM NO	TAKIM ADI	PUANI
1	3424	MARTI	96.6911
2	5901	ALEM-İ FEZA	95.9558
2	0610	SPACE VERTEX	95.9558
4	3410	BOZACILAR	95.5882
5	3431	Pegasus	94.8529
6	3437	Stal Robotik	94.4853
7	5902	ÇELEBİ	93.3823
8	4501	MFL Sci Tech	91.9118
9	3450	ANKA ARGE TAKIMI	90.8088
10	3405	APERION	90.4411
10	5904	HFZ CAELUM CLAVA	90.4411
10	3435	RC MAKERS	90.4411
13	3420	Hydrotech	90.0735
14	3451	EAGLE TECH	87.5000
15	0501	SAC-05	87.1323
15	3442	TRUE ORBIT	87.1323
17	3403	HyperDUx	86.7647
17	6101	GÖKBÖRÜ	86.7647
19	5903	ÇOFSAT	86.0294
20	3406	BAL-SAT	85.6617
21	3449	Nova	84.5588
22	3443	V-SAT	83.4558
23	3446	WAYSAT	81.6176
24	4401	FEZA	81.2500
25	6701	Robotso	79.4118
26	6703	UMUT	78.3088
27	3444	VOYAGER	77.9411
27	3434	PALIEN	77.9411
29	0611	TİM SYNTAX	77.5735
30	0104	ROTATEK	77.2058
31	0607	KOZMİK KARINCALAR	76.8382
32	3415	ESENBIL LAYKA	76.4705
33	5201	GALAXY	75.7352
34	0102	Merih	73.5294
35	4201	AKŞEHİR FEN LİSESİ	71.6911
36	0601	AAL_RMK	69.1176
37	0701	SÜTA	66.1765
38	3440	THE ASGARDIANS	62.1324
39	3427	Nun Model Uvdu	61.0294











TeknoFest 2020 National CanSat Competition



TEKNOFEST 2020 CANSAT COMPETITION



















USA NRL/NASA CANSAT 2020











CanSat Competition

Home Mission Teams Winners Photos Documents Contact Us

Sponsors



VIRGINIA TECH.

2020 Winners

First Place

Univeristy of Hawaii Maui College, USA UHMC Team Onipa'a

Second Place

Universitas Gadjah Mada, Indonesia Narantaka

Third Place University of Manchester, UK

Manchester CanSat Project

Fourth Place

Zonguldak Bülent Ecevit University, Turkey grizu-263

Fifth Place UPIITA, Mexico Team Thor

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AIAA SPACE DESIGN CONTEST 2020 Lunar Base Camp



GLOBAL

University Space Engineering Consortium







CONCEPT OF OPERATION

- 2. Trans-Lunar Injection (TLI)
- 3. Trajectory Correction Maneuver
- 4. Lunar 12-hr Frozen Orbit Insertion for Satellite Deployment
- 5. Descending to the Low Lunar Orbit (LLO) and Landin
- 6. Deployment of Inflatable Habitat
- 7. Regolith Wall by 3D Printers
- 8. Deployment of Solar Panels







AIAA 2021:MARS Ice Core Sample return project





FIGURE 1: CONCEPT OF OPERATIONS





Project.X Türkiye'nin ilk PocketQube Projesi



grizu-263A (grizuSAT)

grizu-263A (grizuSAT) Türkiye'de ürebilecek olan ilk pocketqube projesidir. SXSXS cm boyutlarında olacak olan küp şeklinde bu uydunun üretimi tamamen Zonguldak Bülent Ecevit Üniversitesi'nde gerçekleşecektir. Proje 2018 yılı CanSat Competition Dünya 2 si olan grizu-263 Uzay Takımı tarafından başlabilmıştır.

Uydu 2020 yılının ortasında fırlatılacak ve 500 km yükseklikte yörüngeye yerleştirilecektir.













CUBESAT PROJECTS







Cooperation in the field of space and aeronautics (宇宙・航空分野に関する協力)



JAXA and Republic of Turkey's Ministry of Transport, Maritime Affairs and Communications (JAXAとトルコ共和国 運輸海事通信省)

- Provision of opportunity for long duration material exposure (材料などの長期曝露実験機会)
- Deployment of one cubesat (3U)
 (超小型衛星1機(3U)の放出)





SHARJAHSAT-1 MISSION

- For UNIVERSITY of SHARJAH, UAE
- Capacity development through
 - Science mission: star detection and sun observation
 - Imaging mission: earth and space

- Payload
 - X Ray detector (spesifications given)
 - Optical camera (spesifications to be determined)







TO BE LAUNCH by Q4/2021



Engineering qualification model (EQM) assembly









UoS VHF/UHF GS Established March 2020

ASELSAT MISSION for ASELSAN Company





UNISEC GLOBAL

ASELSAT, January 2021







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Training CubeSat (EDUSAT)





Develop actual mission software for CubeSat





TEKNOFEST 2021















NATIONAL SPACE PROGRAM

Turkish Space Agency

Objectives

- Creating and acquiring facilities and technologies that would ensure independent access to space through the development of space and aeronautics industries,
- Decreasing the dependency on foreign resources, enhancing competitiveness in the international arena,
- Developing the relevant human resources and enhancing our skills and capabilities on spacerelated activities

Duties

In line with the welfare and national interests of our society;

- Ensuring that the use of space and aeronautics technologies become more widespread,
- Developing scientific and technological infrastructure in space and aeronautics technology,
- Building these skills and enhancing capabilities,
- Carrying out relevant work to ensure that other sectors of the national defense industry benefit from the expertise and knowledge acquired through space and aeronautics technologies,
- Supporting R&D and high-tech entrepreneurship,
- Keeping the records of objects on behalf of the State launched into space through international agreements,
- Carrying out the registration work or assigning relevant authorities to carry out the registration work within the UN.







NATIONAL SPACE PROGRAM

1-Moon Mission

Goal

In memory of the 100th Anniversary of the Foundation of the Republic of Turkey, the first contact with the moon will be established.

Stages of the Mission

- During the first stage, the first rough landing will be made on the Moon with our national and authentic hybrid rocket that shall be launched into orbit in the end of 2023 through international cooperation
- During the second stage, the initial launching, which carried our probe to the orbit, will be made through our own rockets and soft landing will be made on the moon

Goals

- To ensure that our country is one of the few countries that could conduct scientific activities on Moon,
- · To acquire experience and knowledge on launching technologies and deep space systems,
- To create the infrastructure necessary for many areas ranging from the technology of radiationresistant equipment to communications, from autonomy to artificial intelligence,
- To enable the commercialization of sub-systems developed through national and domestic resources,
- To increase the awareness within the society on space







NATIONAL SPACE PROGRAM

3-Regional Positioning and Timing System

Goal

Developing a regional positioning and timing system for Turkey

Strategy

- Investing in positioning and timing through projects involving critical technologies
- Creating international collaboration
- Through small-budget technology workshops; the organization of technology show-off events
- Designing and planning an earth-based and space-based structure in a progressive manner

Achievements

- Our country will acquire the skill of independent positioning and timing
- We will develop our own precise navigation applications in defense, agriculture, urbanization and autonomous vehicles,
- We will increase the accuracy of positioning and timing for our country and our region,
- Our country will acquire the technology of positioning and timing systems.



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METU Aerospace Engineering Department



□ Founded in 1981

□ More than 600 students (BS + MS + PhD)

□ Fully Accredited by ABET

- □ Space related undergraduate courses
 - Introduction to Aerospace Engineering (1st year)
 - Space Vehicle Design (4th year)
 - Spacecraft Dynamics (4th year)
 - Introduction to Rocket Technology (4th year)
 - Inertial Navigation Systems (4th year)
 - Introduction to Space Sciences (Graduate)
 - Applied Orbital Mechanics (Graduate)

Close collaboration with the Aerospace Companies and also the research institutes in Ankara.

- Candidate Engineering for 4th year undergrad students.
- Summer training programs







Past Activities

- Students are actively involving in USA CanSat (since 2014) and Teknofest Model Satellite competitions.
- □ APSCO Student Small Satellite (SSS) Project
 - 2nd Summer Camp was held in METU in 2018 for 1 month with attendees from several countries.
 - In collaboration with TUBITAK Space
 Technologies Research Institute, a 3U
 Nanosatellite was developed. 22 students
 involved in the design and development
 process.
- Collaboration in Space themed EU Research Projects
 - AstroNet I-II, The Astrodynamics Network (modeling and attitude control of flexible spacecraft, formation flying using low thrust propulsion, and space inspection and autonomy)
 - DeOrbit Sail, De Orbiting Satellites Using Solar Sails
- □ METU Aerospace Society
 - Member of Euroavia (European Association of Aerospace Students)
 - □ Organization of Annual Aerospace Days.













Present & Future Activities



- □ Forming a more active research group for space activities.
 - Especially for researches on spacecraft guidance, navigation and control.
 - Research papers to be submitted to the 33rd ISTS and International Astronautical Congress 2021.
- □ Improving the curriculum with multiple other space related courses.
 - New courses to be taught starting from next year.
- □ Involvement in international/national competitions.
 - A group of 7 students are working on their proposal for the MIC7.
 - Several teams (2 for now) will be competing in Teknofest Model Satellite Competition this year.
- □ New international / national project proposals.
- □ Space Technology Development Zone
 - As a part of the recently announced National Space Program, a Space Technology Development Zone will be established on METU grounds in Golbasi, Ankara.
 - Close collaboration with other institutes and universities for contributing to the goals of the Space Program.















University of Turkish Aeronautical Association





University of Turkish Aeronautical Association

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TURK HAVA KURUMU UNIVERSIT

University education started in 20

Located in Ankara

Aeronautics and Astronautics

- Business Administration
- Engineering
- ~2500 students





Star Clustering with Machine Learning

Dr.Nevsan Sengil







Star Clustering with Machine Learning





Star Clustering with Machine Learning





Orbit Design — LEO to Moon

- Question: For a CubeSat with electric propulsion system, what are the feasible trajectory alternatives for a Moon Mission from LEO?
- **Key Concepts:** Restricted Three-Body Problem, Low-Energy Trajectories, Particle Swarm Optimization
- Aim: Developing machine learning techniques for determining low-energy trajectories
- Status: M. F. Ertürk, Ş. U. Köprücü, M. M. Gomroki, N. Şengil, T. Ç. Şişman, M. Yaman, *Preliminary Orbit Design for a CubeSat Moon Mission*, accepted for 8th National Aerospace Conference, UHUK-2020-156.



Orbit Design — LEO to Mooil Survey

 We used particle swarm optimization (PSO) algorithms for finding optimized trajectories of minimized propellant and transfer time:





Orbit Design



Orbit Alternatives for Regional Navigation Satellite System (RNSS) for Turkey

- **Question:** What are the building blocks for a regional navigation satellite system?
- **Key Concepts:** (Elliptic) Inclined Geosynchronous Orbits [(E)IGSO], Geometric Dilution of Precision (GDOP)
- Aim: Determining best GDOP and highest elevation satellite system configurations for Turkey region for a stand alone and/or augmentation system
- Status:
 - S. Büyük, Ö. U. Örengül, A. C. Başıbüyük, U. Tuğcular, T. Ç. Sişman and C. Tola, Preliminary Orbit Design for Turkish Regional Navigation Satellite System, 9th International Conference on Recent Advances in Space Technologies (RAST 2019), 279-284, 2019.
 - U. Tuğcular, A. C. Başıbüyük, M. F. Engin, T. Ç. Şişman, C. Tola and H. E. Söken, Design and Optimization of Turkish Regional Navigation Satellite System as an Augmentation System, accepted for 8th National Aerospace Conference, UHUK-2020-166.



Orbit Design



Orbit Alternatives for Regional Navigation Satellite System (RNSS) for Turkey

• We worked on EIGSO and GEO satellites as building blocks like in Quasi-Zenith Satellite



Plan for 2021 and beyond



- Register UNISEC-TR as an association/society
- Close collaboration with TUA
- 11th NanoSatellite Symposium in Turkey, 2022
- RAST 2023 in ISTANBUL
- Continue CubeSat projects (Dept. of Meterology)
- Support to Regional Space Projects
- Support to schools and other educational institutions (space technology seminars)
- Keep it multidisciplinary, multi institutional and international







We Look Forward To a Sustainable Fruitful Cooperation Towards being a civilization living

in the Solar System

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