The 6th Virtual UNISEC-Global Meeting
20 February 2021

Turkish UNISEC (UTEB) Activities

Prof. Dr. Alim Rustem Aslan, UTEB Coordinator, UNISEC Global PoC and StC Manager, Space Systems Design and Test Laboratory
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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 246 years (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
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
- 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 HIGH SCHOOL CANSAT COMPETITION
July 2020
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TeknoFest 2020 National CanSat Competition
TEKNOFEST 2020 CANSAT COMPETITION

MODEL UYDU

TEKNOFEST Havacılık, Uzay ve Teknoloji Festivali kapsamında gerçekleştirilecek olan olan Model Uydu Yarışması, Türks...

DETAYLAR
EL UYDU
İŞİMAŞI

İTÜ APİS AR-GE
İstanbul Teknik Üniversitesi

Behiç

protek

protek

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USA NRL/NASA CANSAT 2020

- Rocket launches.
- Container launches.
- CanSat is deployed from the rocket.
- Glider is released autonomously from the Container.
- Payload glides in a circular pattern with a 250m radius above 100m for at least one minute.
- Payload deploys a parachute to descend safely while collecting and transmitting desired data.
- Payload lands, initiates sound generation and is ready for recovery.
- Container continues to descend.
- Container completes its descent and initiates sound generation.
- Rocket and CanSat ascend.
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
AIAA SPACE DESIGN CONTEST 2020
Lunar Base Camp

**LUNAR BASE CAMP PROJECT - FROZEN FOREST**
The first attempt at an expandable, multi-functional and international base camp on the moon.

**STEPS**
1. Establishment of Power Infrastructure
2. Deployment of Lab Module
3. Deployment of Hab Module and Assembly

**Deployment**
Mission Duration: 9 months - Construction of A Fully Functional Base Until 2031 for a Crew of Four

**CONCEPT OF OPERATION**
1. Low Earth Orbit Trajectory (LEO)
2. Trans-Lunar Injection (TLI)
3. Trajectory Correction Maneuver
4. Lunar 12 hr Proximity Orbit Insertion for Satellites Deployment
5. Descending to the Low Lunar Orbit (LLO) and Landing
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 üretilcek olan ilk pocketqube projesidir. 5x5x5 cm boyutlarında olacak olan küp şeklinde bu projemizin üretilen ürünü Zonguldak Büyünç University’nde gerçekleştirilecektir. Proje 2018 yılı CarSat Competition Dünya 2.si olan grizu-263A Uzay Takımı tarafından başarılmıştır.
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)
SHARJAH SAT -1

TO BE LAUNCH by Q4/2021
Engineering qualification model (EQM) assembly
UoS VHF/UHF GS
Established March 2020
ASELSAT MISSION for ASELSAN Company
Training CubeSat (EDUSAT)

Develop actual mission software for CubeSat
TEKNOFEST 2021

COMPETE IN THE WORLD'S BIGGEST TECH COMPETITIONS

- ROCKET COMPETITION
- HELICOPTER DESIGN COMPETITION
- MODEL SATCHEL COMPETITION
- BIOTECHNOLOGY INNOVATION COMPETITION
- FLYING CAR DESIGN COMPETITION
- ENVIRONMENT AND ENERGY TECHNOLOGIES COMPETITION
- JET ENGINE DESIGN COMPETITION
- EDUCATION TECHNOLOGIES COMPETITION
- ROBOTICS COMPETITION
- SMART TRANSPORTATION COMPETITION
- AGRICULTURAL TECHNOLOGIES COMPETITION
- ARTIFICIAL INTELLIGENCE COMPETITION
- UNMANNED AERIAL VEHICLE COMPETITION
- UNMANNED AERIAL VEHICLE SWARM COMPETITION
- FIGHTING UNMANNED AERIAL VEHICLE COMPETITION
- EFFICIENCY CHALLENGE ELECTRIC VEHICLE COMPETITION
- ROBOTAXI-FULL SCALE AUTONOMOUS VEHICLE COMPETITION
- TECHNOLOGY FOR HUMANITY COMPETITION
- COMMUNICATION TECHNOLOGIES COMPETITION
- TRAVEL HACKATHON
- TURKEY DRONE CHAMPIONSHIP
- AGRICULTURAL UNMANNED LAND VEHICLE COMPETITION
- DIGITAL TECHNOLOGIES COMPETITION IN INDUSTRY
- ISTANBUL INTERNATIONAL INVENTIONS FAIR (SIIF)
- UNIVERSITY STUDENTS RESEARCH PROJECTS COMPETITIONS
- WORLD DRONE CUP
- UNIVERSITY STUDENTS RESEARCH PROJECTS COMPETITIONS
- HIGH SCHOOL STUDENTS POLAR RESEARCH PROJECTS COMPETITION
- HIGH SCHOOL STUDENTS UNMANNED AERIAL VEHICLE COMPETITION

APPLICATION DEADLINE FEBRUARY 28 '21
NATIONAL SPACE PROGRAM

www.tua.gov.tr
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 space-related 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.
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 radiation-resistant 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.
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.
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

- University education started in 2011
- Located in Ankara
- Faculties
  - Aeronautics and Astronautics
  - Air Transportation
  - Business Administration
  - Engineering
- ~2500 students
Star Clustering with Machine Learning

Dr. Nevsan Sengil
Star Clustering with Machine Learning

Machine Learning

Unsupervised Machine Learning

K-Means

Mean-Shift

Density-Based

Supervised Machine Learning

Gaussian Models

Regression

Classification

Clustering

Hierarchical
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

Orbit Design — LEO to Moon

• We used particle swarm optimization (PSO) algorithms for finding optimized trajectories of minimized propellant and transfer time:
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:
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 System (Quasi-Zenith Satellite System) for Turkey.
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
RAST 2019, 11-14 JUNE 2019
SPACE for SUSTAINABLE DEVELOPMENT GOALS
We Look Forward To a Sustainable Fruitful Cooperation
Towards being a civilization living in the Solar System

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