| Project | Description | Supervisor |
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| Metamaterials based Radar cloaks to hide UAVs | The aim of this project is to develop a thin layer to hide UAVs from the radar signals using metamaterials. | Prof. Dr. Diaa Gadelmavla |
| Developemnt of a enviromental friendly renewable energy based rechargable drone (RF + Solar energies) | Develoment of an enviromental friendly UAV by collecting solar and RF energies from surroundings while on fly and on ground. | Prof. Dr. Diaa Gadelmavla |
| Developement of high enduracnce UAV for forest fire detection. | A specially designed drone will be equipped with sensors and onboard detection systems for forest fire detection and warning system | Prof. Dr. Diaa Gadelmavla |
| Autonomous optical and inertial navigation of a solar-sail propelled CubeSat class spacecraft targeting Mars and its moons. | In Project 1, the students will develop a software tool capable of simulating the acquisition of star fields by a CCD camera coupled to a small telescope onboard a CubeSat-class vehicle traveling to the Mars system by using the thrust produced by a solar sail. The system will automatically determine the plate constants by identifying known stars and it will measure the positions of beacon asteroids in the star field. By solving an inverse problem, the position and velocity of the spacecraft in space will be calculated and compared to the nominal trajectory (Project 3) so as to obtain necessary corrections. This information will be augmented by the use of onboard accelerometers for the measurement of non-gravitational forces. This project will use only Free Open Source software tools employed by students in all classes I teach, including, but not necessarily limited to, the Free Wolfram Engine on Jupyter Notebooks, Fortran 95, and Scilab/Xcos, in both Windows and Linux emulation environments. The reliability of the final product shall be verified by means of synthetic stellar images, including sources of noise and systematic errors, as well as actual images taken from the ground. Using this toolset, students working on Project 1 shall act as members of the Navigation and Flight Dynamics team for this CubeSat mission to Mars. | Asst. Prof. Fabrizio Pinto |
| Proof-of-concept of a solar-sail propelled CubeSat class spacecraft digital twin targeting Mars and its moons. | In Project 2, students will develop software tools needed to operate the "digital twin" — in the sense defined in the space industry —of a CubeSat-class vehicle traveling to the Mars system by using the thrust produced by a solar sail. For instance, in response to status reports from the Flight Dynamics Team (Project 1), and since the spacecraft shall be assumed to be auto-navigating, the software tools to be developed by students working on this Project 2 shall describe important maneuvers, such as orienting the sail as needed, and the behavior of various subsystems during such events. The approach used will make use of multiphysics models and feedback control strategies. This project will use only Free Open Source software tools employed by students in all classes I teach, including, but not necessarily limited to, the Free Wolfram Engine on Jupyter Notebooks, Fortran 95, and Scilab/Xcos in the Open Modelica language, in both Windows and Linux emulation environments. The reliability of the final product shall be verified by generating simulated status reports and verifying that the spacecraft takes appropriate corrective actions. Using this toolset, students working on Project 2 shall act as Spacecraft Controllers and members of the Spacecraft Operations team. | Asst. Prof. Fabrizio Pinto |
| Trajectory design and flight dynamics of a solar-sail propelled CubeSat class spacecraft targeting Mars and its moons. | In Project 3, students will design the trajectory of a CubeSat-class vehicle traveling to the Mars system by using the thrust produced by a solar sail. The goal is to produce a detailed and realistic deterministic nominal trajectory to serve as the blueprint for a mission to take place in an upcoming launch window, starting from a parking Medium Earth Orbit (MEO) and ending at Mars. The mission will consist of a first phase to spiral out of the Earth-Moon system, of a second low-thrust cruise phase to gain energy to reach Mars, and a final phase terminating with deployment of a payload inside the atmosphere of Mars, or sample gathering from the surfaces of Martian moons, or entering a permanent orbit around Mars. Crucial is a realistic description of the properties of solar sails and of the radiative properties of the vehicle. This project will use only Free Open Source software tools employed by students in all classes I teach, including, but not necessarily limited to, the NASA General Mission and Analysis Tool (GMAT), the Free Wolfram Engine on Jupyter Notebooks, Fortran 95, and Scilab/Xcos, in both Windows and Linux emulation environments. The reliability of the final product shall be verified by generating trajectories by means of various, independent tools, aided also by analytical calculations, including perturbation theory. The students working on Project 3 shall act as Trajectory Designers in the Mission Design team. | Asst. Prof. Fabrizio Pinto |
| ULTRA-HIGH TEMPERATURE COMPOSITE FOR HYPERSONIC SYSTEMS | Over the last decades, three-dimensional (3D) textile composite structures have been developed to overcome those disadvantages of laminate composites. The development of 3D textile composites has been undertaken largely by NASA and other space companies and driven by the need of reducing fabrication costs and improving mechanical properties for advanced applications such as hypersonic systems. 3D textile composites containing textile preforms have the following mechanical characteristics: improved stiffness and strength in the thickness direction, elimination of the interlaminar surfaces due to integrated structure, possibilities of near-net-shape design and manufacturing. The aim of this project at Izmir economic University is to research the technology readiness which would enable us to use lightweight 3D Titanium metal matrix composite and ceramic matrix composites materials for high-temperature hypersonic applications such as wing leading edges and hot engine-section components that see significant heating increase due to aerothermal issues. This project focuses on 3D composites designing and manufacturing to be damage tolerant, lighter, and meet the performance and producibility challenges of future flying vehicles flying at high speed. The project contributes the certification of 3D ceramic composites for supersonic and hypersonic aircraft structures is accelerated through the progress of improved models for damage analysis and an in-depth understanding of damage progression in different modeling scales for different flying regimes. | Asst. Prof. Abbasali Saboktakin |
| HYPERVELOCITY IMPACT OF LIGHTWEIGHT COMPOSITE | This research at the aerospace department of Izmir University of Economics is the line of modelling using finite element technique to overcome materials and time cost for the manufacturing of several high strength ceramic composite and comprehensively understanding the mechanical behaviour of ceramic composite subject to hypervelocity impacts. The research is focused on Micro-scale to mesoscale modelling of ceramic composite consist of reinforced carbon fibers that are placed inside the matrix. A finite element method is implemented to analyse the wave propagation generated in the impact region during very short time intervals on the order of microseconds. The objective of this project of the study is to investigate the effect of through-thickness fiber on wave propagation occurred in hypervelocity impact. In this project, to achieve a stable solution along with sufficient accuracy, the best effort will be to use appropriate FEM software. Furthermore, in this research, we aim to conduct a series of high velocity and hypervelocity impact test that impact speeds are on the order of 3 km/s and higher. This database facilitates the determination of the optimum architecture to provide the desired mechanical properties including impact damage tolerance properties for the primary aerospace structure. | Asst. Prof. Abbasali Saboktakin |
| DEVELOPMENT OF HYPERSONIC GUN-LAUNCHED VEHICLE | Orbital debris poses increasing threats to the space environment because of increasing space activities. One major application of research on the hypervelocity impact is to protect spacecraft from the hazard of this space debris. While there is much experimental work being completed to analyse the hypervelocity impact test, it is difficult to make numerous on-orbit tests to investigate the effect of debris on spacecraft structures. Ground-based experiments and numerical simulation are two essential methods for this matter. The on-orbit hypervelocity impact is simulated using the experiment by launching projectiles into the target. Generally, ground-based experiments include three major sectors: projectile launch, impact monitoring including shock wave and debris cloud formation imaging, and finally result processing. Experimental ground-based hypervelocity impact research is a significant tool for determining the properties of composite materials subjected to hypervelocity debris. A variety of experimental hypervelocity test facilities can simulate orbital debris collision conditions. Various acceleration techniques such as light two and three-stage gas guns, plasma accelerators, electrostatic accelerators, and shaped charge accelerators have been used. This project will focus to develop a three-stage gas gun that are most relevant to our research at Izmir economic university that would improve our research in the field of hypervelocity impact tests. The three-stage light gas guns as highly versatile tools for hypervelocity testing are researched. In this vehicle, the energy from the propellant combustion is transferred to a light gas such as helium/hydrogen in the pump pipe via the pressure piston. High pressures are applied to the light gas until it reaches the pressure of diaphragm rupture. Hot compressed gas can be expanded into the launch tube, accelerating the projectile, which is protected from hot gas and acceleration forces by plastic covers. Beside our experimental efforts, simulation will be used for the identification and assessment of different operating parameters of the test conditions without risk to the hypervelocity facility such as high temperature, high pressure, and presence of explosive gases as well as the validation of design concepts, conduct detail design and fabricate and build a subscale prototype system for performance evaluation. | Asst. Prof. Abbasali Saboktakin |
| Design and Development of a Single Copter UAV | Single copter type unmanned aerial vehicles can be used indoors or in environments with low air circulation. The issue of the development of these vehicles, which can be used in places that are difficult for people to enter or dangerous for people, is still up to date. The aim of this project is to develop a UAV of this design that is heavy enough to be carried by a single person and can take part in reconnaissance and surveillance missions. What is expected in the development process is to make various concept designs and compare the advantages and disadvantages and select the most suitable design. Then, what is required is to make the necessary power and aerodynamic calculations, to choose the necessary electronic and mechanical equipment for the flight and to detail the design according to the selected equipments. The outcome of the project will be the production of the first ready-to-fly prototype. | Asst. Prof. Osman Nuri ŞAHİN |
| Agricultural Drone | One of the usage areas of unmanned aerial vehicles is agricultural use. Drones are used effectively in tasks such as crop spraying, which can be difficult and inconvenient to be done by humans. In this project, it is aimed to develop a drone that can perform agricultural spraying and seed sowing. It is expected during the project to design a drone that can carry a spraying tank which has enough liquid capacity for 500m2 of land, and to integrate a pump and spray equipments , and to design the seed sowing system. | Asst. Prof. Osman Nuri ŞAHİN |