AEROTACT

Aero-Tactical Application for Remote Operations and Cargo Transportation

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TX 2.3: Flight Computing and Avionics: Avionics Tools, Models, and Analysis

TX 4.5: Robotic Systems: Autonomous Rendezvous and Docking

TX 10.4: Autonomous Systems: Engineering and Integrity

TX 12.3: Materials, Structures, Mechanical Systems, and Manufacturing: Mechanical Systems

TX 15.1: Flight Vehicle Systems: Aerosciences

TX 15.2: Flight Vehicle Systems: Flight Mechanics

Abstract - Executive Summary

Modern-day drone missions are restrained due to their size and maneuverability. There has never been a successful drone-only NASA mission. The Aero-Tactical Application for Remote Operations and Cargo Transportation, AEROTACT for short, is a new type of quad-rotor drone that will have the ability to fly both as a quadcopter but also transform into an airplane and fly as a fixed-winged aircraft. It has the potential to be used in both future inter solar-system exploration missions as well as for search and rescue missions here on Earth. In order to move forward with the design of AEROTACT first several trade studies will need to be conducted with respect to the type of materials, batteries, rotors, airfoils, and GNC systems that will be used on AEROTACT. Then several months will be spent creating the design of the system and doing qualification by analysis before then creating a prototype and moving on to more robust qualification testing which would include several flight and payload tests. Finally, within the next, there will be a full design that has been qualified by analysis and will be ready to create the first prototype that will be used for more robust flight tests.

Technology Merit and Work Plan

The concept and its future applications

VTOL (Vertical Take-Off and Landing) drone designed to operate autonomously and acquire cargo-carrying and land surveying capabilities.

Due to its cargo-carrying capability, it has the ability to efficiently transport items to remote or inaccessible areas. The drone's land surveying capabilities will enable capabilities such as recording data and imagery for applications such as land mapping, environmental monitoring, and aiding in geological studies. With the AEROTACT's cargo capabilities, the drone can deliver needed equipment and supplies, enabling NASA to further understand terrestrial environments.

Overview of the current state of the art metrics

With a focus on electric propulsion, urban air mobility, autonomous technology, and military and logistics applications, the VTOL aircraft sector has made major advancements. Electric VTOL planes have attracted interest because of their potential to lower emissions and operating expenses. The development of autonomous technology has also paved the road for effective and safe autonomous flight. The adaptability of VTOL aircraft has been further increased by military and logistical uses. Infrastructure development, including vertiports and charging stations, is essential for VTOL technology to be widely used.

KPPs (Key Performance Parameters)

The Key Performance Parameters for the project are the system to be able to efficiently transport cargo without exceeding certain amounts of power (that would require power sources too big for the aircraft to sustain) but at the same be able to cover enough flight time and distance range to complete the missions. The maximum payload it is able to handle would also be a key performing factor. The airfoils performance in terms of simulation, and experimentation will also be crucial in determining the material to be used for the particular operation.

Differences with previous NASA projects

Aero-Tactical Application for Remote Operations and Cargo Transportation will be used to perform autonomous flight capabilities with implications for carrying cargo along with land surveying capabilities. AEROTACT is the name of the aircraft. The aircraft will be capable of vertical takeoff and landing, hence allowing for greater efficiency during fixed-wing flight, and longer loiter times during helicopter flight.

Technical challenges and risks with completion

The key technical challenges involved with the completion of this proposal are the mass of the battery, along with desired performance affecting the endurance of AEROTACT. Thus, its endurance is crucial in order to conduct operations. Installing sensors for the drone would assist in safe landings, situational awareness, and collision avoidance hence avoiding obstacles during flight such as birds, cliffs, trees, and various obstacles. Without human guidance for navigation and the use of autonomous flight, a GPS system would need to be applied, working in conjunction with sensors and cameras along the airframe. If maintenance is not carried out regularly, then this would result in unsafe and hazardous flying. In order to be able to carry cargo, the drone would have to be made of sturdy material that can hold a decent amount of weight. Drones can also be hacked into and taken advantage of to trespass territories and government property. (See Risk Assessment Matrix.)

Overview of the development work plan

The development work plan will consist of designing a Clark Y airfoil in both Fusion 360 (for its CNC capabilities) and Solidworks (for its simulation capabilities). The Clark Y airfoil design was chosen due to its sufficient airfoil section as it provides a high life drag ratio and limits the stall during takeoff and landing.

Our goal with the AEROTACT is to safely haul items to remote areas; however, some restraints and roadblocks must be addressed during this project. During flight, the AEROTACT should handle various weather conditions and obstacles. Sensors and various cameras along the airframe can be utilized to allow greater situational awareness while encountering such conditions as well as the type of materials — Aluminum alloys and 15% Steel content required to prevent structural failures. Furthermore, the engineers will handle how AEROTACT will land and take off from a particular place without any defects. The scientists handle GPS services regarding how the drone should maneuver easily in order to reach a certain destination for transporting items, as well as acting upon autonomous flight. AEROTACT should act in a fixed-wing situation capable of generating lift through the forward airspeed. Its classification consists of the Bell A821201 airfoil for Wing Root and Tip that has a 23% thickness capable of long endurance flight. The Tilt Rotor for the AEROTACT operates with 4 propeller fans that point in the (-z) direction for takeoff/landing and tilt in the (+x) direction for a forward motion. The group has decided to rely on the SunnySky X2212 Brushless Motors that attach to the VTOL Aircraft Propulsion for providing a higher thrust rating at a low throttle setting thus operating at longer times with high strength and resistance to fatigue.

Challenges

The challenges associated with this research and development vary from testing of possible materials to the effective movement, synchronization of the electrical and mechanical systems, and all along with software development. Two of the main issues of this project within its earth applications are the ability to reach a wide range in flight time and finding a power source strong enough to be able to complete take-offs, landings, and possible payload-related activities. Regarding possible extraterrestrial activities, it’s important to take into account the differences in atmosphere that would be encountered on different planets and the changes in air density and speed that would impact the wings and their lift production.

Differences and affinities with similar technology development efforts

This idea is complementary to many aeronautical companies developing VTOLs aircraft for transporting civilians from one location to another in order to avoid road traffic. Our team's goal is to develop a VTOL that is capable of transporting cargo to remote areas, examining geographical terrains, and surveying weather predictions.

Project Management Approach

Project management approach for the technology development activity

The project management approach for the technology development activity prioritizes fostering clear communication among the team. This involves organizing regular meetings to address the individual needs of team members and ensuring everyone remains on track. The project managers take on the responsibility of supporting the team to the best of their abilities. Additionally, they play a crucial role in facilitating the Internal Review of the proposal.

Outreach

Strategies for outreach and sponsorship are essential for connecting individuals and growing an organization. Engaging target audiences, increasing brand visibility, and establishing credibility can all be achieved by using social media, publishing research, and attending conferences.

Social media such as Instagram, Twitter, LinkedIn, etc can be utilized to showcase the growth and development of the team's progress over time. This will allow people to become familiar with our brand as a team and generate more interest in the development process and end product. This will establish our presence as a reputable brand and increase the credibility of our team. Our team can also attend local conferences and or club events to grow our connections and opportunities. These strategies enable wider outreach, fostering collaborations and partnerships for mutual growth and impact.

Teaming and Workforce Development

- **Vishruth Balaji**, *Programmatic Lead*: Undergraduate student with Proficient Coding/Solidworks Expertise and Supersonic Wind Tunnel Testing
- **Francesca Afruni**, *Engineer*: Undergraduate Aerospace Engineering student with C++, Matlab, and NX Siemens experience
- **Xuan Dao**, *Programmatic Assistant*: MATLAB, SOLIDWORKS, XFLR5, OpenVSP, Numerical Methods
- **Jonathan Chang,** *Engineer*: Undergraduate Aerospace Engineering Student, Python, Solidworks
- **Autumn Brown**, *Science Lead*: Undergraduate Mechanical Engineering student with minors in math and physics, proficiencies in AutoDesk Inventor, Solidworks, and NX Siemens
- **Aryan Verma,** *Engineer*: Undergraduate Mechanical Engineering student with strengths in Python, Siemens NX, MATLAB, C++, and SolidWorks
- **Kyle Richichi,** *Engineering Co-Lead*: Undergraduate Mechanical Engineering, MATLAB, SOLIDWORKS, SIEMENS NX, PYTHON, CATIA, AUTOCAD, 3D Printing and CNC experience
- **Nicolas Ahmed**, *Principal Investigator*: Undergraduate Aerospace Engineering student, AutoCAD, Inventor, Fusion360, CNC lathe, 3D Printing, and soldering
- **Jason Dionida,** *Engineer*: Undergraduate Mechanical Engineering student with a minor in Aerospace Engineering, proficient in MATLAB, Solidworks, Siemens NX, AutoCAD, C++, C, C#, Numerical Methods
- **Carlos Lopez,** *Project Manager*: Undergraduate Air traffic controller/pilot, Aviation background with strengths in communication skills and teamwork skills.
- **Tyler Swingler,** *Engineering Co-Lead*: Undergraduate Aerospace Engineering student with capabilities in Solidworks, Fusion 360, 3D printing, RC design, soldering, and knowledge in electrical.
- **Giuseppe Afruni**, *Subject Matter Expert*: Chief Test Pilot at Leonardo Company, helicopter division.

Appendix

Quad Chart for Subteam 6: Quad-Tilt Rotor RC Aircraft - Now AEROTACT

SB-6, Quad Chart

Quad-Tilt Rotor RC Aircraft

PI: Nicolas Ahmed

Team 28, Subteam-06

Goal / Objective

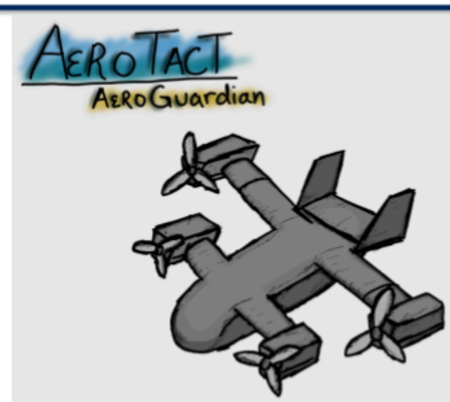
- Describe your project. Provide the agency / national need addressed, objectives of the project, and value proposition.

  An RC 4-engine VTOL drone craft capable of vertical and fixed-wing flight. With the possibilities to survey large areas of land, conduct overwatch of hazardous environment or rescue operations. And perform light cargo capabilities

  Does your concept qualify for an NTR?

  No, RC-VTOL aircraft are an existing technology but is not widely used.
- Clearly define the final products of the investment

  An 4-engine capable Remote Control -VTOL aircraft capable of fixed-wing flight, hover capabilities and extended lotter times.



Team Overview

TX 15: Flight Vehicle Systems

- Carlos Lopez - Community College of Baltimore County - Air Traffic Control/ Pilot
- Kyle Richichi - North Carolina State University - Mechanical Engineering
- Jonathan Chang - Texas A&M University - Aerospace Engineering
- Jason Dionida - Santa Clara University - Mechanical Engineering
- Vishruth Balaji - Texas A&M University - Aerospace Engineering
- Autumn Brown - Virginia Commonwealth University - Mechanical Engineering
- Francesca Afruni - Florida Institute of Technology - Aerospace Engineering
- Aryan Verma - Michigan State University - Mechanical Engineering
- Nicolas Ahmed - Texas A&M University - Aerospace Engineering
- Xuan Dao - California State University, Long Beach - Aerospace Engineering
- Tyler Swingler - Arizona State University - Aerospace Engineering
- SME pending

Undergraduate aerospace and mechanical engineering students with minors in math and physics, proficiencies in AutoDesk, Inventor, Solidworks, Fusion360, Siemens NX CAD, Catia, Matlab, C++, Python, 3D printing, CNC lathes and machines, soldering, and supersonic wind tunnel testing.Undergraduate aerospace and mechanical engineering students with minors in math and physics, proficiencies in AutoDesk, Inventor, Solidworks, Fusion360, Siemens NX CAD, Catia, Matlab, C++, Python, 3D printing, CNC lathes and machines, soldering, and supersonic wind tunnel testing.

TX 01.2.2 Electrostatic

Metrics and Key Performance Parameters

- How does the "future state" of the concept impact the cost, schedule and/or risk to future NASA activities

  The implications of this technology could be used for earth use, and with modification could be used for mars as a land, and lightweight cargo capabilities.
- Note the state-of-the-art / current best practice
  - Quantify the metrics improved at the mission level

With existing technologies, what remains is a concept prototype, and software.

The technology readiness level of this would be, 1

Gantt Chart: *Schedule/Gantt Chart - Team 28.xlsx*

L'SPACE NPWEE Summer 2023 - AEROTACT: Aero-Tactical Application for Remote Operations and Cargo Transportation

Team Number: 28

Francesca Afruni, Nicolas Ahmed, Vishruth Balaji, Autumn Brown, Jonathan Chang, Xuan Dao, Jason Dionida, Carlos Lopez, Kyle Richichi, Tyler Swingler, and Aryan Verma

Project Start: Tue, 8/1/2023

Display Week: 1

ID#	TASK	ASSIGNED TO	PROGRESS	START	END	DAYS	Margin
1	**Selection of Instrumentation**		0%	8/1/23	8/31/23	31	9
1.1	Perform a trade study to select materials	Engineering	Not complete	8/1/23	8/10/23	10	
1.2	Draft final Bill of Materials (BOM)	Admin, Engineering	Not complete	8/10/23	8/18/23	9	
1.4	Schedule Margin			8/19/23	8/27/23	9	
1.5	◆ Purchase Instruments and Materials		Not complete	8/28/23	8/31/23	4	
2	**Verification of Electronics Functionality**		0%	9/1/23	9/23/23	23	6
2.1	Complete table top assembly of flight system	Electrical, Engineering	Not complete	9/1/23	9/5/23	5	
2.2	Verify nominal functionality	Science	Not complete	9/6/23	9/11/23	6	
2.3	Perform callibration of dector and flight system	Electrical, Engineering	Not complete	9/12/23	9/18/23	7	
2.5	Schedule Margin			9/18/23	9/23/23	6	
2.6	◆ Completion of Hardware Check		Not complete	9/23/23	9/23/23	1	
3	**Completion of Data handling, Acquisition, and Conditioning**		0%	9/24/23	10/15/23	22	6
3.1	Install needed drivers	Sofware	Not complete	9/24/23	9/26/23	3	
3.2	Write test program for functionality	Sofware	Not complete	9/26/23	10/9/23	14	
3.5	Schedule Margin			10/9/23	10/14/23	6	
3.6	◆ Completion of Data Handeling Set-up		Not complete	10/14/23	10/15/23	2	

ID#	TASK	ASSIGNED TO	PROGRESS	START	END	DAYS	Margin
4	**Validation of Detector Performance**		0%	10/16/23	10/29/23	14	2
4.1	Perform Thermal Vacuum Tests	Science, Engineering	Not complete	10/16/23	10/21/23	6	
4.2	Perform Vibration Chamber Tests	Science, Engineering	Not complete	10/21/23	10/24/23	4	
4.3	Perform Simulated Atmosphere Tests	Science, Engineering	Not complete	10/24/23	10/29/23	6	
4.5	Schedule Margin			10/30/23	10/31/23	2	
4.6	◆ Preliminary Instrument Tests Complete		Not complete	10/31/23	10/31/23	1	
5	**Completion of Final Instrument Design**		0%	11/1/23	12/19/23	49	15
5.1	Complete Final Draft of CAD	Engineering	Not complete	11/1/23	11/14/23	14	
5.2	Print Version #1 of Science Payload/Instrument Housing	Science, Engineering	Not complete	11/14/23	11/18/23	5	
5.3	Revise Design Based on Testing	Engineering	Not complete	11/18/23	11/23/23	6	
5.4	Print Version #2 of Science Payload/Instrument Housing	Science, Engineering	Not complete	11/23/23	11/27/23	5	
5.5	Fininalize Design	Science, Engineering	Not complete	11/28/23	12/2/23	5	
5.6	Schedule Margin			12/3/23	12/17/23	15	
5.7	◆ Print Final Housing in Space Grade Polymer		Not complete	12/18/23	12/19/23	2	

ID#	TASK	ASSIGNED TO	PROGRESS	START	END	DAYS	Margin
6	**Execution of Housed Instrument Testing**		0%	12/20/23	1/30/24	42	3
6.1	Perform Thermal Vacuum Test on Print #1	Science, Engineering	Not complete	12/20/23	12/23/23	4	
6.2	Perform Vibration Chamber Test on Print #1	Science, Engineering	Not complete	12/24/23	12/28/23	5	
6.3	Perform Simulated Atmosphere Test on Print #1	Science, Engineering	Not complete	12/28/23	1/1/24	5	
6.4	Perform Thermal Vacuum Test on Print #2	Science, Engineering	Not complete	1/2/24	1/6/24	5	
6.5	Perform Vibration Chamber Test on Print #2	Science, Engineering	Not complete	1/7/24	1/10/24	4	
6.6	Perform Simulated Atmosphere Test on Print #2	Science, Engineering	Not complete	1/11/24	1/14/24	4	
6.7	Perform Thermal Vacuum Test on Final Print	Science, Engineering	Not complete	1/15/24	1/19/24	5	
6.8	Perform Vibration Chamber Test on Final Print	Science, Engineering	Not complete	1/20/24	1/23/24	4	
6.9	Perform Simulated Atmosphere Test on Final Print	Science, Engineering	Not complete	1/24/24	1/27/24	4	
6.10	Schedule Margin			1/28/24	1/30/24	3	
6.11	◆ Detector Housing Design Complete and Tested		Not complete	1/30/24	1/30/24	1	
7	**Completion of Critical Design Review (CDR) Presentation**		0%	2/1/24	3/1/24	30	5
7.1	Draft 1 of CDR	All	Not complete	2/1/24	2/10/24	10	
7.2	Revise CDR	All	Not complete	2/11/24	2/19/24	9	
7.3	Final Draft of CDR	All	Not complete	2/20/24	2/23/24	4	
7.4	Schedule Margin			2/24/24	2/28/24	5	
7.5	◆ CDR Presentation		Not complete	2/29/24	3/1/24	2	

Risk Assessment Chart/Matrix: *Risk Matrix - Team 28.xlsx*

NPWEE Team 28 AEROTACT Risk Summary

ID	Summary	Risk Statement	Status
1	Mission's battery shall fit within weight and endurance requirements	The mission's battery shall be light enough such that the drone's flight systems can light the power systems payload. The mission's battery shall meet endurance and power requirements to complete the selected mission timeline. If, at any point, the battery's weight falls outside of these requirements, the mission shall fail. If, at any point, the battery's endurace and power levels begin to operate below the minimum power requirements, the mission shall fail.	
2	Mission sensors shall continue to operate at throughout the mission timeline	Mission sensors shall operate at 80% of max capacity throughout the mission timeline. Mission sensors shall assist in safe landings and acoiding obstacles during all stages of flight. If, at any point, the mission sensors begin to operate below 80% of max capacity, the mission shall fail.	
3	Maintenance shall be carried out regularly throughout the mission	Maintenance and cleaning shall be carried out regularly over the mission's timeline such that the mission can properly avoid unsafe and hazardous flying. If, at any point, the mission's maintenance or cleaning are not carried out reguluarly such that the mission cannot fly safely, the mission shall fail.	
4	Mission's structure shall remain structurally sound	Mission's structure shall remain structurally sound throughout the mission's timeline. The mission's structural material chosen shall remain structurally sound such that the mission can carry the cargo/payload's weight throughout the mission's timeline. If, at any point, the mission's structure ceases to be structurally sound such that it can no longer carry the mission's cargo/payload, then the mission shall fail.	
5	Mission's software and data handling systems shall remain protected from unwanted users	Mission's software and data handling systems shall remain behind a secure firewall, protected from unwanted users who might want to take advatage and tresspass. If, at any point, the mission's data or software is leaked, hacked, or otherwise trespassed by unwanted user(s), then the mission shall fail.	

Budget Overview Chart: *Budget Outline - Team 28*

NASA L'SPACE NWPEE Team 28 AEROTACT

Year	Yr 1 Total	Yr 2 Total	Yr 3 Total	Yr 4 Total	Yr 5 Total	Cumulative Total
OUTREACH						
Total Outreach Materials	$ -	$ 35.00	$ 35.00	$ 35.00	$ 35.00	**$ 140.00**
Total Outreach Venue Costs	$ -	$ -	$ -	$ -	$ -	**$ -**
Total Outreach Costs	$ -	$ 35.00	$ 35.00	$ 35.00	$ 35.00	**$ 140.00**
DIRECT COSTS						
|> Science Instrumentation	$ -	$ -	$ -	$ -	$ -	**$ -**
|> Other Payload Costs	$ -	$ -	$ -	$ -	$ -	**$ -**
Total Payload Costs	$ -	$ -	$ -	$ -	$ -	**$ -**
|> Mechanical Subsystem	$ 200.00	$ 200.00	$ 200.00	$ 200.00	$ 200.00	**$ 1,000.00**
|> Power Subsystem	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	**$ 500.00**
|> Thermal Control Subsystem	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	**$ 250.00**
|> Comms/Data Handling Subsystem	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	**$ 250.00**
Total Vehicle Costs	$ 400.00	$ 400.00	$ 400.00	$ 400.00	$ 400.00	**$ 2,000.00**
|> Manufacturing Facility Cost	$ -	$ -	$ 400.00	$ 400.00	$ 400.00	**$ 1,200.00**
|> Test Facility Cost	$ -	$ -	$ 800.00	$ 800.00	$ 800.00	**$ 2,400.00**
Total Facilities Costs	$ -	$ -	$ 1,200.00	$ 1,200.00	$ 1,200.00	**$ 3,600.00**
Manufacturing Margin	$ 160.00	$ 160.00	$ 640.00	$ 640.00	$ 640.00	**$ 2,240.00**
Total Direct Costs	$ 560.00	$ 560.00	$ 2,240.00	$ 2,240.00	$ 2,240.00	**$ 7,840.00**
Total MTDC	$ 160.00	$ 160.00	$ 160.00	$ 160.00	$ 160.00	**$ 800.00**
FINAL COST CALCULATIONS						
Total F&A	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	**$ 80.00**
Total Projected Cost	$ 576.00	$ 611.00	$ 2,291.00	$ 2,291.00	$ 2,291.00	**$ 8,060.00**
Total Cost Margin	$ 115.20	$ 122.20	$ 458.20	$ 458.20	$ 458.20	**$ 1,612.00**
Total Project Cost	$ 691.20	$ 733.20	$ 2,749.20	$ 2,749.20	$ 2,749.20	**$ 9,672.00**
********** Do not change percentages in the boxes below unless mission concept instructions specify otherwise.						
F&A %	10%	10%	10%	10%	10%	
Manufacturing Margin	40%	40%	40%	40%	40%	
Total Cost Margin	20%	20%	20%	20%	20%	
ERE - Staff	28%	28%	28%	28%	28%	

New Technology Report, NTR (NASA form 1679):

National Aeronautics and Space Administration	**Disclosure of Invention and New Technology (Including Software)**	Form Approved O.M.B. NO. 2700-0052	DATE 2023-07-18
		CONTRACTOR CASE NO.	

This is an important legal document. Carefully complete and forward to the Patent Representative (NASA in-house innovation) or New Technology Representative (contractor/grantee innovation) at NASA. Use of this report form by contractor/grantee is optional; however, an alternative format must at a minimum contain the information required herein. NASA in-house disclosures should be read, understood and signed by a technically competent witness in the witness signature block at the end of this form. In completing each section, use whatever detail deemed appropriate fora "full and complete disclosure." Contractors/Grantees please refer to the New Technology or Patent Rights – Retention by the Contractor clauses. When necessary, attach additional documentation to provide a full, detailed description.

NASA CASE NO. (OFFICIAL USE ONLY)
NONE

1. DESCRIPTIVE TITLE
AEROTACT - Aero-Tactical Application for Remote Operations and Cargo Transportation

2. INNOVATOR(S) *(For each innovator provide: Name, Title, Work Address, Work Phone Number, and Work E-mail Address. If multiple innovators, number each to match Box 5.)*
Nicolas Ahmed, , 551 E Tyler Mall, Tempe, AZ, 85281, 8324889489, wiki.kiki12330@gmail.com
Kyle Richichi, , 551 E Tyler Mall, Tempe, AZ, 85281, 9199249728, ktrichichi@gmail.com

3. INNOVATOR'S EMPLOYER WHEN INNOVATION WAS MADE *(For each innovator provide: Name, Division and Address of Employer, Organizational Code/Mail Code, and Contract/Grant Number if applicable. If multiple innovators, number each to match Box 5.)*
ASU L'SPACE NPWEE ACADEMY, 551 E Tyler Mall, Tempe, AZ, 85281, , 80NSSC19M0186
NASA L'SPACE NPWEE Academy, 551 E Tyler Mall, Tempe, AZ, 85281, , 80NSSC19M0186

4. PLACE OF PERFORMANCE *(Address(es) where innovation made)*
551 E Tyler Mall, Tempe, AZ, 85281
551 E Tyler Mall, Tempe, AZ, 85281

5. EMPLOYER STATUS *(choose one for each innovator)*

CU	*CU*
Innovator #1	*Innovator #2*
Innovator #3	*Innovator #4*

GE = Government
CU = College or University
NP = Non-Profit Organization
SB = Small Business Firm
LE = Large Entity

6. ORIGIN *(Check all that apply and provide all applicable numbers. If multiple Contracts/Grants, etc., list Contract/Grant Numbers in Box 3 with applicable employer information.)*
[] NASA In-house Org. Mail Code
[] Grant/Cooperative Agreement No.
[] Prime Contract No.
Task No. Report No.
[] Subcontractor: Subcontract Tier
[] Joint Effort (contract, subcontractor and/or grantee contributions(s), and NASA in-house contribution)
[] Multiple Effort (multiple contractor, subcontractor and/or grantee contributions, no NASA in-house contribution)
[] Other (e.g., Space Act Agreement, MOA) No.

7. NASA CONTRACTORING OFFICER'S TECHNICAL REPRESENTATIVE (COTR)

8. CONTRACTOR/GRANTEE NEW TECHNOLOGY REPRESENTATIVE (POC)
/

9. BRIEF ABSTRACT *(A general description of the innovation which describes its capabilities, but does not reveal details that would enable duplication or imitation of the innovation.)*
The goal of this project is to develop a Remote Control 4-engine VTOL Drone Aircraft, which is capable of fixed wing and vertical flight, with capabilities such as conducting overwatch of hazardous environmental risks, rescue operations, light cargo capabilities, and potential help in Space Operations. In order to do so, we have devised a plan, where we intend to determine the right materials, in order to ensure that we have the right vehicle in mind for operation, such as first using SolidWorks to determine the airfoil by running simulations. Then finalizing a CAD Drawing that would give the details of our final product, which will be the vehicle. We could also potentially use a wind tunnel for experimentation.

SECTION I – DESCRIPTION OF THE PROBLEM OR OBJECTIVE THAT MOTIVATED THE INNOVATION'S DEVELOPMENT (Enter as appropriate: A. – General description of problem/objective; B. – Key or unique problem characteristics; C. – Prior art, i.e., prior techniques, methods, materials, or devices performing function of the innovation, or previous means for performing function of software; and D. – Disadvantages or limitation of prior art.)
Previous NASA Missions have been designed with a likeness to helicopters (for example: the Mars Perseverance rover and its detachable helicopter Ingenuity), however, Ingenuity is limited in its range and payload abilities due to its size. Ingenuity helped the Perseverance mission by navigating into hard-to-reach areas, and "In its operational role, Ingenuity is observing areas of interest for possible examination by Perseverance" (NASA Science) This describes the pricelessness of agility when gathering payload samples and information in an extraterrestrial mission.

SECTION II – TECHNICALLY COMPLETE AND EASILY UNDERSTANDABLE DESCRIPTION OF INNOVATION DEVELOPED TO SOLVE THE PROBLEM OR MEET THE OBJECTIVE (Enter as appropriate; existing reports, if available, may form a part of the disclosure, and reference thereto can be made to complete this description: A. – Purpose and description of innovation/software; B. – Identification of component parts or steps, and explanation of mode of operation of innovation/software preferably referring to drawings, sketches, photographs, graphs, flow charts, and/or parts or ingredient lists illustrating the components; C. – Functional operation; D. – Alternate embodiments of the innovation/software; E. – Supportive theory; F. – Engineering specifications; G. – Peripheral equipment; and H. – Maintenance, reliability, safety factors.)
Due to its cargo-carrying capability, it has the ability to efficiently transport items to remote or inaccessible areas. With the drone's land surveying capabilities, this will enable capabilities such as to record data and imagery for applications such as land mapping, environmental monitoring, and aiding in geological studies. With the AEROTACT's cargo-capabilities, the drone can deliver needed equipment and supplies, enabling NASA to further understand terrestrial environments.

SECTION III – UNIQUE OR NOVEL FEATURES OF THE INNOVATION AND THE RESULTS OR BENEFITS OF ITS APPLICATION (Enter as appropriate: A. – Novel or unique features; B. – Advantages of innovation software; C. – Development or new conceptual problems; D. – Test data and source of error; E. – Analysis of capabilities; and F. – For software, any re-use or re-engineering of existing code, use of shareware, or use of code owned by a non-federal entity.)

Aero-Tactical Application for Remote Operations and Cargo Transportation, will be used to perform autonomous flight capabilities with implication for carrying cargo along with land surveying capabilities. AeroGuardian is the name of the aircraft. The aircraft will be capable of vertical takeoff and landing, hence allowing for greater efficiency during fixed wing flight, and longer loiter times during helicopter flight.

SECTION IV – SPECULATION REGARDING POTENTIAL COMMERCIAL APPLICATIONS AND POINTS OF CONTACT (Including names of companies producing or using similar products.)

The AEROTACT technology would be applicable not only in NASA exploration missions but also on Earth missions. For example, AEROTACT could be used for search and rescue missions for lost sea craft or for delivering supplies to difficult-to-reach areas after an earthquake.

10. ADDITIONAL DOCUMENTATION *(Include copies or list below any pertinent documentation which aids in the understanding or application of the innovation (e.g., articles, contractor reports, engineering specs, assembly/manufacturing drawings, parts or ingredients list, operating manuals, test data, assembly/manufacturing procedures, etc.).)*

TITLE	PAGE	DATE

11. DEGREE OF TECHNOLOGY SIGNIFICANCE *(Which best expresses the degree of technological significance of this innovation?)*

[X] Modification to Existing Technology [] Substantial Advancement in the Art [] Major Breakthrough

12. STATE OF DEVELOPMENT

[X] Concept Only [X] Design [] Prototype [] Modification [] Production Model [] Used in Current World

13. PATENT STATUS (Prior patent on/or related to this innovation)

Patent Num: Patent Issue Date: App Serial Num: App Serial Issue Date:

14. INDICATE THE DATE OR THE APPROXIMATE TIME PERIOD WHICH THIS INNOVATION WAS DEVELOPED *(i.e. conceived constructed, tested, etc.)*

Start: End:

15. PREVIOUS OR CONTEMPLATED PUBLICATION OR PUBLIC DISCLOSURE INCLUDING DATES *"(Provide as applicable: A. - Type of publication or disclosure, e.g. report, conference or seminar, oral presentation; B. - Disclosure by NASA or Contractor/Grantee; and C. - Title, volumne no., page no., and date of publication*

16. QUESTIONS FOR SOFTWARE ONLY

(a) Using non-NASA employees to beta-test the program? [ ]YES [ ]NO If Yes, done under a beta-test agreement? []YES []NO
(b) Modification of this program continued by civil servant and/or contractual agreement? []YES []NO
(c) Copyrighted registered? []YES []NO []UNKNOWN If Yes, then by whom?
(d) Has the lastest version been distributed outside of NASA or contractor? []YES []NO []UNKNOWN
(e) Were prior version distributed outside of NASA or Contractor? []YES []NO [] UNKNOWN If Yes, supply NASA or contractor contact
(f) Contains or based on code not owned by U.S. Government or its contractors? []YES []NO []UNKNOWN
If Yes, name of code and codes' owner
Has a license for use been obtained? []YES []NO []UNKNOWN

17. DEVELOPMENT HISTORY

STAGE OF DEVELOPMENT	DATE (MM/YYYY)	LOCATION	IDENTIFY SUPPORTING WITNESSES (NASA in-house only)
a. First disclosure to others	/		
b. First sketch, drawing, logic chart or code	/		
c. First written description	/		
d. Completion of first model of full size device *(invention)* or beta version *(Software)*	/		
e. First successful operational test *(invention)* or alpha version *(Software)*	/		

f. Contribution of innovators *(if jointly developed, provide the contribution of each innovator)*

g. Indicate any past, present, or contemplated government use of the innovation

18. SIGNATURES OF INNOVATOR(S), WITNESS(ES), AND NASA APPROVAL

TYPED NAME AND SIGNATURE	DATE	TYPED NAME AND SIGNATURE	DATE
TYPED NAME AND SIGNATURE *(Innovator #1)*	DATE	TYPED NAME AND SIGNATURE *(Innovator #2)*	DATE
TYPED NAME AND SIGNATURE *(Innovator #3)*	DATE	TYPED NAME AND SIGNATURE *(Innovator #4)*	DATE
TYPED NAME AND SIGNATURE *(Innovator #5)*	DATE	TYPED NAME AND SIGNATURE *(Innovator #6)*	DATE
NASA APPROVED	TYPED NAME	SIGNATURE	DATE

References:

Airfoil Geometries. Embry-Riddle Aeronautical University, 2022, https://eaglepubs.erau.edu/introductiontoaerospaceflightvehicles/chapter/airfoil-geometries/.

Boeing CH-47 Chinook - the Landing Gear. www.chinook-helicopter.com/standards/areas/gear.html.

CLARK Y AIRFOIL (Clarky-il). www.airfoiltools.com/airfoil/details?airfoil=clarky-il.

Dreese, John. *DesignFOIL NACA Airfoil Coordinates and Airfoil Design Software*. www.dreesecode.com/index.html.

Özgür Dündar, Mesut Bilici, Tarık Ünler, *Design and performance analyses of a fixed wing battery VTOL UAV*, Engineering Science and Technology, an International Journal, Volume 23, Issue 5, 2020, Pages 1182-1193, ISSN 2215-0986, https://doi.org/10.1016/j.jestch.2020.02.002.

Chaderjian, Neal M. and NASA Ames Research Center. "A Decade of Discovery in Rotorcraft Simulation With NASA Supercomputing." *NASA@SC22*, www.nas.nasa.gov/SC22/research/project5.html.

Imumbhon, Johnson Okoduwa, et al. *'Structural and CFD Analyses of a Reciprocating-Airfoil (RA) Driven UAV Wing under Maximum Lift and Inertia Forces'*. Drone Systems and Applications, vol. 10, no. 1, 2022, pp. 287–308, https://cdnsciencepub.com/doi/10.1139/dsa-2021-0043.

Top-Design CNC Suspension Nose Landing Gear Strut With Twin Wheel 160mm - (5.0). www.rc-castle.com/index.php?route=product/product&product_id=8359.