Title:	Guidance for the Use of UAS During Suboptimal Environmental Conditions
The Problem:	TxDOT is interested in using a UAS platform combined with visible/infrared close-range photogrammetry for a wide range of applications including (but not limited to): 1. Inspection of bridges, towers, and other structures, 2. Rapid collection of data to expedite vehicular crash clearance from roadways, 3. Damage assessment following natural disasters, 4. Real-time monitoring of events and locations such as real-time traffic monitoring or the monitoring of wildfire progression. Environmental conditions including wind, rain, mist, smoke, and ambient lighting affect both the flight operations of the UAS aircraft and the quality of the data being collected. However, due to logistics, scheduling, and urgency, many UAS flights will be performed during suboptimal conditions. For safe, effective, and efficient use of this technology the following questions must be answered: 1. When do environmental conditions preclude the use of UAS for safety or other operational reasons? 2. How do localized ancillary conditions, such as wind vortices near structure, impact the use of UAS and how can those affects be minimalized? 3. How do various environmental conditions impact the quality of the data being collected and in particular the image data quality in terms of resolution and resolving power? 4. How do flights conditions (e.g., high dynamic flight conditions) affect photo block restitution using SIFT and SLAM algorithms? 5. Do UAS augmented technologies such as Real-Time Kinematic GPS and Inertial Measurement units (IMUs) aid in flight operations or the quality of the data being collected during suboptimal conditions? A major challenge of using UAS during suboptimal conditions is the impact on the quality of data collected. To ensure the quality of UAS data, several key UAS components must be addressed: 1. Stability of airframe and propellers and in particularly stability against development of transient high-frequency vibrations. 2. Responsiveness of gyro stabilization hardware. 3. Reliability of built-in stabilization in the cameras. 4. Sensitivity and latency of the IMU. 5. Synchronization of the camera shutter event and the IMU measurement. 6. Resolving power of the sensors. 7. Safe and long-endurance path planning (optimal reference trajectory). 8. The sensor position and orientation during data acquisition. The findings from this research are expected to provide important insights and recommendations and guidance for UAS flight crew training, flight plan development, and future wide-range UAS applications in Texas.

Technical Objectives:	The objective of this project is to address key challenges of UAS operations in suboptimal environmental conditions, provide guidance for UAS flight operations in suboptimal conditions, and recommend settings, procedures and workflows to ensure data quality collected by UAS in suboptimal conditions. The researchers shall address the following: 1. Conduct literature review. 2. Develop simulation and lab testing procedures and protocols. 3. Perform simulation and lab tests and develop analytics and assessments. 4. Conduct preliminary field testing of UAS flight operations and data collection in suboptimal environmental scenarios. 5. Perform field testing post-flight analytics and assessments. 6. Develop recommendations and guidance for UAS operations in suboptimal conditions. The research team must include a certified photogrammeter experienced with photogrammetry applications using UAS. The expectation of this project is that the end product will obtain a TRL level 8.
Desired Deliverables:	1. Technical memorandum for each task completed. 2. Monthly progress reports. 3. Value of Research (VoR) that includes both qualitative and economic benefits, to be included in the final research report. 4. Research report documenting the findings of the research, including a list of recommendations, guidelines, and demonstrations of selected UAS applications for operation in suboptimal environmental conditions. 5. Project Summary Report.
Proposal Requirements:	1. Utilize the “Proj/Agre” and “PA_Form” templates located at the TxDOT RTI website. 2. Proposals will be considered non-responsive and will not be accepted for technical evaluation if they are not received by the deadline or do not meet the requirements stated in RTI's University Handbook, which is also located at the RTI website. 3. Proposals should be submitted in PDF format, 1 PDF file per proposal. File name should include project name and university abbreviation. 4. This project will be tracked during the life of the project using a Technology Readiness Level (TRL) scale. For more information about the use of a TRL, click.