STANDARD OPERATING PROCEDURES

Safety Procedures

I. General

The field data collection process of roundabouts and other innovative intersections usually involves measuring and recording roadway geometric and operational features along with capturing images/videos of intersection operations with drone-mounted and tripod-mounted cameras. Due to the delicate nature of the aircraft and cameras, mishandling the equipment may lead to component malfunction, serious injury, and property damage. This standard operating procedure provides safety guidelines regarding the aircraft operation and field data collection to minimize the risks. The aircraft discussed in this document is the INSPIRE™ 2 model manufactured by DJI, and the compatible camera is the Zenmuse X5S™.

II. Drone Operation Safety Guidelines

Since many aircraft components are sensitive to the surrounding environment like temperature, air density, etc. and their performance could change drastically under different conditions, users should first be familiar with the aircraft and its limitations, then operate the aircraft in a safe and responsible manner to avoid any serious injury or property damage. The following guidelines discuss some basic principles that users should always follow during each stage of the aircraft operation. For more detailed operating rules, users can refer to the safety guidelines prepared by DJI using this link.

A. Flight Condition Requirements

- Operate the aircraft only in good to moderate weather conditions with temperatures between -4° and 104° F (-20° to 40° C). Never fly during severe weather conditions including wind speeds exceeding 22 mph (10 m/s), snow, rain, smog, heavy wind, hail, lightning, tornadoes, or hurricanes, etc.

- Keep the aircraft at least 30 feet (10 meters) away from obstacles, people, animals, buildings, public infrastructure, trees, and bodies of water when in flight. As the altitude increases, the safe distance between the aircraft and above objects should also increase.

- Operate the aircraft in open areas only. Tall buildings or steel structures may affect the accuracy of the on-board compass and block the GPS signal.

- Do not operate the aircraft near areas with magnetic or radio interference, which include high voltage lines, large scale power transmission stations or mobile base stations, and broadcasting towers, etc.

B. Pre-flight Checklist

- Ensure the remote controller, Intelligent Flight Battery, and mobile device are fully charged.

- Ensure that camera lens is clean and free of stains, the Micro SD card has been inserted into the camera, and the gimbal can rotate freely before powering it on.

- Ensure the propellers and mounting plates are securely mounted onto the motors, and the motors can start and function normally.

- Follow the on-screen instructions to calibrate the compass.

- Ensure the DJI GO 4 app and aircraft's firmware have been upgraded to the latest version.

- Ensure that the flight area is outside the NO-Fly Zones and flight conditions are suitable for flying the aircraft.

- Ensure that the drone pilots are not flying under the influence of alcohol, drugs or any substance that may impair cognitive abilities to operate the aircraft safely.

- Be familiar with the selected flight mode and understand all safety functions and warnings.

- Be sure to observe all local, state, and federal regulations. Obtain appropriate authorizations and understand the risks.

- Always maintain line of sight of the aircraft and do not only rely on first person view camera to control the aircraft.

- Ensure the DJI GO 4 app is properly launched to assist the aircraft operation and record the flight data.

C. Operation

- Avoid interference between the remote controller and other wireless equipment. Make sure to turn off the Wi-Fi on your mobile device.

- Do not answer incoming calls and avoid using mobile devices during flight.

- Read all prompted safety tips, warning messages, and disclaimers carefully in the DJI GO 4 app. Land the aircraft immediately at a safe location if there is an alert shown on the app.

- Do not apply external force to the gimbal after the gimbal is powered on. Handle with care and do not touch the gimbal connector, as any damage can lead to malfunction.

- Do not switch from P-mode to either A-mode or S-mode unless you are sufficiently familiar with the aircraft's behavior for each flight mode, since disabling GPS may result in being unable to land the aircraft safely.

- Do not pull the left stick to the bottom inside corner and press the Return-to-Home (RTH) button at the same time when the aircraft is airborne unless in an emergency situation. This combination command feature can be turned off via the DJI GO 4 app.

- Ensure antennas of the remote controller are unfolded and adjusted to proper tension to achieve optimal transmission quality. Make sure to always fly the aircraft within the transmission range of the remote controller.

- Always be alert when in control of the aircraft as the vision system may be disabled in certain situations (e.g., bad lighting or unclear obstacle surface patterns). Do not fly closely above reflective surfaces such as water or snow as they can affect the performance of the vision system.

- The aircraft cannot automatically brake and stop at a safe distance from an obstacle if the aircraft speed exceeds 31.3 mph (14 m/s).
- Land immediately when severe drifting occurs in flight, i.e., the aircraft does not fly in straight lines.
- When battery warnings are triggered, promptly bring the aircraft back to the Home Point or land at a safe location to avoid losing power during flight and causing damage to the aircraft, property, animals, and people.
- Ensure the landing gear is lowered before landing. Do not attempt to catch or hold the aircraft because the landing gear will be lowered if the Vision Position System detects an object and may cause injury.
- Only power off the aircraft and the remote controller after the motors stop rotating. After landing, first stop the motor, power off the aircraft, and turn off the Intelligent Flight Battery, then turn off the remote controller.
- While safety and flight assistance features such as obstacle avoidance, aircraft stabilization, and Return-to-Home are designed to assist aircraft operation, pilots' discretion will still be needed, especially in case of emergency.

D. Local Laws and Regulations Observation

- Avoid operating the aircraft in the vicinity of manned aircraft, regardless of altitude.
- Avoid operating the aircraft in densely populated areas, including cities, sporting events, exhibitions, performances, etc.
- Do not fly the aircraft above the authorized altitude and never higher than 400 ft (120 m) above ground level. Stay clear of and do not interfere with manned aircraft operations.
- Do not fly the aircraft near or inside NO-Fly zones specified by local or federal laws and regulations. The NO-Fly zone list includes airports, borders between two sovereign countries or regions, etc. A complete list of No-Fly zones can be found at http://www.dji.com/flysafe/no-fly.

- Always keep the aircraft within a visual line of sight and use an additional observer to assist if necessary.

- Respect the privacy of others when using the camera, comply with local privacy laws, regulations, and moral standards.

E. Product Care

- Store the Intelligent Flight Battery and remote controller in a cool, dry place away from direct sunlight. The recommended storage temperature ranges from 71° to 82° F (22° to 28° C) for storage periods of more than three months. Do not store them in environments outside the temperature range of -4° to 113° F (-20° to 45° C).

- Keep the camera away from water or other liquids. If it gets wet, wipe off any water droplets with a soft, absorbent dry cloth, and do not use substances containing alcohol, benzene, thinners, or other flammable substances to clean the camera. Do not store the camera in humid or dusty areas.

- Detach the gimbal from the aircraft if the aircraft will be stored for a long period of time or transported over long distances.

- Do not connect the aircraft to any USB interface that is older than version 2.0.

- Check every part of the aircraft after any crash or violent impact. Contact a DJI authorized dealer directly if any problems or issues are detected.

- Fully charge and discharge the battery at least once every three months to maintain battery health, and keep the battery level between 40% and 65% for long-term storage.

- The aircraft is recommended to be returned to the manufacturer for service after every 50 hours of flight time to ensure proper performance.

III. Field Data Collection Safety Guidelines

In addition to capturing images/videos with drone-mounted camera, the field data collection process often includes in-situ measurement and recording of the intersection operational and

geometric characteristics data. Below are the guidelines that the survey crew should follow to ensure a safe and efficient data collection process.

- Ensure that every survey crew member wears a traffic safety vest at all times. The vest must be put on before surveyors set off from their base to the selected intersection site(s). The vest must be worn on top of all other clothing.

- The survey must be carried out by at least two surveyors; One can serve as a lookout to warn of potential hazards while the other does the main survey work.

- Ensure that every survey crew member is in good physical condition, including sight and hearing.

- Do not enter the active travel lanes at any time if there is no measurement that requires crew members to be in the active travel lane.

- Avoid working on wet pavement in an active traffic area, allow sufficient time for pavements to be fully dried after rain before performing any surveys.

- Survey vehicle must be parked off the road at any available parking spot close to the intersection such as a gas station or store front. Turn off all lights including headlights and emergency lights if the parking spot is within 60 meters of intersection.

- Place safety signs or traffic cones in front of the parked vehicles in the direction of oncoming traffic to help enhance the visibility of survey crew.

- All state-specific safety guidelines should be followed including those outlined in the GDOT Automated Survey Manual. The GDOT Automated Survey Manual can be downloaded using this link.

Safety Procedure Checklist

Safety Procedure Checklist		
General Information	Project Number:	Comments
	Date:	
	Time:	
	Recorder:	
Drone Operation		**Check**
Flight Condition Requirements	Operate the aircraft only in good to moderate weather conditions with temperatures between -4° and 104° F (-20° to 40° C). Never fly during severe weather conditions including wind speeds exceeding 22 mph (10 m/s), snow, rain, smog, heavy wind, hail, lightning, tornadoes, or hurricanes, etc	
	Keep the aircraft at least 30 feet (10 meters) away from obstacles, people, animals, buildings, public infrastructure, trees, and bodies of water when in flight. As the altitude increases, the safe distance between the aircraft and above objects should also increase	
	Operate the aircraft in open areas only. Tall buildings or steel structures may affect the accuracy of the on-board compass and block the GPS signal	
	Do not operate the aircraft near areas with magnetic or radio interference, which include high voltage lines, large scale power transmission stations or mobile base stations, and broadcasting towers, etc.	
Pre-flight Checklist	Ensure the remote controller, Intelligent Flight Battery, and mobile device are fully charged	
	Ensure that camera lens is clean and free of stains, the Micro SD card has been inserted into the camera, and the gimbal can rotate freely before powering it on	
	Ensure the propellers and mounting plates are securely mounted onto the motors, and the motors can start and function normally	
	Follow the on-screen instructions to calibrate the compass	
	Ensure the DJI GO 4 app and aircraft's firmware have been upgraded to the latest version	
	Ensure that the flight area is outside the NO-Fly Zones and flight conditions are suitable for flying the aircraft	
	Ensure that the drone pilots are not flying under the influence of alcohol, drugs or any substance that may impair cognitive abilities to operate the aircraft safely	

	Be familiar with the selected flight mode and understand all safety functions and warnings	
	Be sure to observe all local, state, and federal regulations. Obtain appropriate authorizations and understand the risks	
	Always maintain line of sight of the aircraft and do not only rely on first person view camera to control the aircraft	
	Ensure the DJI GO 4 app is properly launched to assist the aircraft operation and record the flight data	
In-flight Operation	Avoid interference between the remote controller and other wireless equipment. Make sure to turn off the Wi-Fi on your mobile device	
	Do not answer incoming calls and avoid using mobile devices during flight	
	Read all prompted safety tips, warning messages, and disclaimers carefully in the DJI GO 4 app. Land the aircraft immediately at a safe location if there is an alert shown on the app	
	Do not apply external force to the gimbal after the gimbal is powered on. Handle with care and do not touch the gimbal connector, as any damage can lead to malfunction	
	Do not switch from P-mode to either A-mode or S-mode unless you are sufficiently familiar with the aircraft's behavior for each flight mode, since disabling GPS may result in being unable to land the aircraft safely	
	Do not pull the left stick to the bottom inside corner and press the Return-to-Home (RTH) button at the same time when the aircraft is airborne unless in an emergency situation. This combination command feature can be turned off via the DJI GO 4 app	
	Ensure antennas of the remote controller are unfolded and adjusted to proper tension to achieve optimal transmission quality. Make sure to always fly the aircraft within the transmission range of the remote controller	
	Always be alert when in control of the aircraft as the vision system may be disabled in certain situations (e.g., bad lighting or unclear obstacle surface patterns). Do not fly closely above reflective surfaces such as water or snow as they can affect the performance of the vision system	
	The aircraft cannot automatically brake and stop at a safe distance from an obstacle if the aircraft speed exceeds 31.3 mph (14 m/s)	
	Land immediately when severe drifting occurs in flight, i.e., the aircraft does not fly in straight lines	

	When battery warnings are triggered, promptly bring the aircraft back to the Home Point or land at a safe location to avoid losing power during flight and causing damage to the aircraft, property, animals, and people	
	Ensure the landing gear is lowered before landing. Do not attempt to catch or hold the aircraft because the landing gear will be lowered if the Vision Position System detects an object and may cause injury	
	Only power off the aircraft and the remote controller after the motors stop rotating. After landing, first stop the motor, power off the aircraft, and turn off the Intelligent Flight Battery, then turn off the remote controller	
	While safety and flight assistance features such as obstacle avoidance, aircraft stabilization, and Return-to-Home are designed to assist aircraft operation, pilots' discretion will still be needed, especially in case of emergency	
Local Laws and Regulations Observation	Avoid operating the aircraft in the vicinity of manned aircraft, regardless of altitude	
	Avoid operating the aircraft in densely populated areas, including cities, sporting events, exhibitions, performances, etc.	
	Do not fly the aircraft above the authorized altitude and never higher than 400 ft (120 m) above ground level. Stay clear of and do not interfere with manned aircraft operations	
	Do not fly the aircraft near or inside NO-Fly zones specified by local or federal laws and regulations. The NO-Fly zone list includes airports, borders between two sovereign countries or regions, etc.	
	Always keep the aircraft within a visual line of sight and use an additional observer to assist if necessary	
	Respect the privacy of others when using the camera, comply with local privacy laws, regulations, and moral standards	
Drone Product Care	Store the Intelligent Flight Battery and remote controller in a cool, dry place away from direct sunlight. The recommended storage temperature ranges from 71° to 82° F (22° to 28° C) for storage periods of more than three months. Do not store them in environments outside the temperature range of -4° to 113° F (-20° to 45° C)	
	Keep the camera away from water or other liquids. If it gets wet, wipe off any water droplets with a soft, absorbent dry cloth, and do not use substances containing alcohol, benzene, thinners, or other flammable substances to clean the camera. Do not store the camera in humid or dusty areas	
	Detach the gimbal from the aircraft if the aircraft will be stored for a long period of time or transported over long distances	

	Do not connect the aircraft to any USB interface that is older than version 2.0	
	Check every part of the aircraft after any crash or violent impact. Contact a DJI authorized dealer directly if any problems or issues are detected	
	Fully charge and discharge the battery at least once every three months to maintain battery health, and keep the battery level between 40% and 65% for long-term storage	
	The aircraft is recommended to be returned to the manufacturer for service after every 50 hours of flight time to ensure proper performance	
Field Data Collection		**Check**
Field Data Collection Safety Guidelines	Ensure that every survey crew member wears a traffic safety vest at all times. The vest must be put on before surveyors set off from their base to the selected intersection site(s). The vest must be worn on top of all other clothing	
	The survey must be carried out by at least two surveyors; One can serve as a lookout to warn of potential hazards while the other does the main survey work	
	Ensure that every survey crew member is in good physical condition, including sight and hearing	
	Do not enter the active travel lanes at any time if there is no measurement that requires crew members to be in the active travel lane	
	Avoid working on wet pavement in an active traffic area, allow sufficient time for pavements to be fully dried after rain before performing any surveys	
	Survey vehicle must be parked off the road at any available parking spot close to the intersection such as a gas station or store front. Turn off all lights including headlights and emergency lights if the parking spot is within 60 meters of intersection	
	Place safety signs or traffic cones in front of the parked vehicles in the direction of oncoming traffic to help enhance the visibility of survey crew	
	All state-specific safety guidelines should be followed including those outlined in the GDOT Automated Survey Manual	
Operator Signature		