Open Geospatial Consortium

OGC Code Sprint:

GeoPose - An Introduction to the Hillyfields Bubble Dataset

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OGC GeoPose SWG

UNCLASSIFIED

Introduction to GeoPose

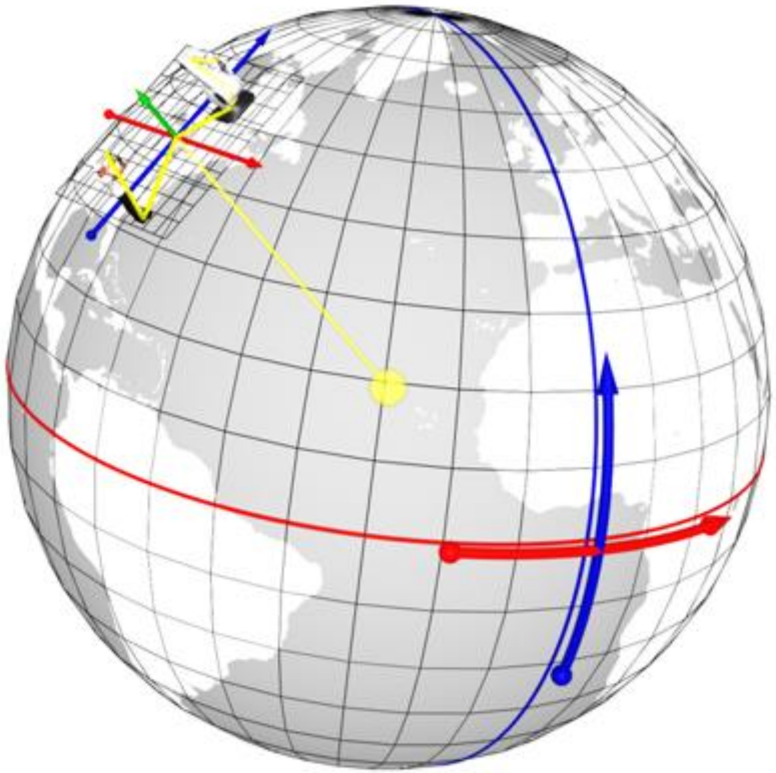
Requirement

We frequently need a standard to describe location of an object with 6 degrees of freedom – x, y, z, roll, pitch, yaw (Position and orientation).

Vision

Enabling two or more arbitrary systems to exchange position and orientation of objects.

- A **Pose** captures position and orientation of a real or digital object.
- It has an associated **FrameTransform** – Information to transform Pose geometry between reference frames.
- A **Fixed Pose** is a Pose whose outermost frame is related to an object with an externally defined position/orientation (**Ephemeris Object**).
- A **GeoPose** is a **Fixed Pose** related to a geospatial **Ephemeris Object** (the Earth).



Research Objectives

Current Problem

Developing algorithms for mutually visible sensors in 3D requires comparisons of the differing properties of competing designs.

Lack of consistent open-source 3D datasets to fulfill this.

Those that exist have a lack of interoperability, often being derived from proprietary systems.

Our Objectives

A series of capture "runs" using multiple platforms and sensors to capture 3D data to fulfill this problem.

Provision a well-documented and realistic open-source dataset to support development and benchmarking.

To examine multiple implementations and use cases for OGC and other standards.

Who/What Needs Data? - The Use Cases

Metaverse Standards Forum: Ride Hailing

- Part of "Assisted Car/Human Urban Rendezvous."
- Create virtual designations (a virtual sign) for a requested car and rider. Each designation moves and orientates to face.
- Interfaces for external services.

OGC Testbed-19: Road Hazard Monitoring

- Use cases: wrong way vehicles and roadside litter monitoring.
- Identify moving vehicles using video/sensors in Android app. And litter with cameras/LiDAR on vehicle.
- Process W3C WebVMT - an open format to sync video with an animated, annotated map.

OGC Testbed-19 GeoPose in a Minkowski Bubble

- Explore issues with extension of OGC GeoPose for use in a Minkowski spacetime.
- Reduce speed of light to 1.02 x velocity of fastest sensor platform.
- Check correctness of the spacetime extension using animations of the captured Poses

OGC Testbed-19 GeoPose in Euclidean Space, Time, and Minkowski Spacetime

- Demonstrate interoperability with GeoPoses in Euclidean 3-space plus absolute time.
- A simulated platform in orbit to relate the Bubble Euclidean frame + time and the orbiter's Minkowski frame.
- This necessitates a Minkowski metric to get the spacetime interval between reference frames.

Data Capture

We captured a multipurpose dataset inside a 3D spherical region of radius 256m, centred near the Ordnance Survey headquarters in Southampton, UK

Capture Type	Sensors
UAV (Mavic 2)	Camera, video, GPS, compass, accelerometer, gyroscope
GoPro Chest-Mounted	Camera, video, GPS, IMU
Static Camera (Mobile App)	Camera, GPS, IMU, WebVMT
Simulated Orbital Platform	Camera (for 25cm resolution).
OS StreetDrone Vehicle	Camera x 2, LiDAR, GPS-RTK, IMU

All sensor capture was orchestrated around the movement of the StreetDrone.

Results

- 12 capture runs over 2 days in mixed conditions were performed.
- Due to the complicated nature of the different platforms and sensors, not all data sources were available for each run.
- However, enough sensors were functioning across the captures to fulfil all the use-cases.
- The availability of data from the different sensors is shown to the right.

The use cases are Rendezvous (RV), Road Hazard (RH), GeoPose in a Minkowski Bubble (GM) and GeoPose in Euclidean Space, Time, and Minkowski Spacetime (GEaM).

Capture	Camera (Static Phone)	Camera (GoPro)	Cameras (Street-Drone)	LiDAR (Street-Drone)	GPS-RTK (Street-Drone)	Use Case
230425_r1	☒	☒	☒	☑	☑	GM GEaM
230425_r2	☒	☒	☒	☑	☑	GM GEaM
230425_r3	☑	☒	☒	☑	☑	GM GEaM, RV
230425_r4	☑	☒	☒	☑	☑	GM GEaM
230425_r5	☑	☒	☒	☑	☑	GM GEaM
230425_r6	☒	☒	☑	☑	☑	GM GEaM
230425_r8	☑	☑	☑	☑	☒	GM GEaM RH RV
230425_r9	☑	☒	☑	☑	☑	GM GEaM RH
230426_r1	☒	☑	☑	☒	☑	GM GEaM RH RV
230426_r2	☑	☒	☑	☒	☑	GM GEaM RH
230426_r3	☑	☑	☑	☒	☑	GM GEaM RH RV

Open-Source Data Artefacts

The data artefacts are available in the open-source repository.

Further metadata about the contents of the data, and naming conventions/indexing, can be found in the repository readme and files alongside the data.

Further data at:
http://hillyfieldsbubble.org

Type	Description
LiDAR (scan)	10Hz collection as packet file (pcap). Raw packets can be georeferenced or aggregated using SLAM algorithm.
Point Cloud	Point cloud map from individual scans. Compressed laz format.
StreetDrone Video	Uncompressed or compressed at 5 frames per second. 2MP, front and rear facing capture. Mp4 format.
StreetDrone Imagery	Individual frames from both cameras, compressed as png.
Drone Point Cloud	~2 x 10^7 points covering full extent. Laz format.
Drone Video	Video capture for each run from 50m altitude. Mp4 format.
INS output - GPS/IMU (Position/orientation)	Output roll, pitch, yaw, latitude, longitude, GPS status with accurate timings at 100Hz, as csv file.
Static Camera Video	Video capture of StreetDrone and other passing vehicles/pedestrians. Mp4 format.
WebVMT	Synchronised position and video data, recorded from phones and StreetDrone. Vmt extension.