

Spatial Programming Project Proposal: Python Tool to Process and Visualize Swarm Diver Data



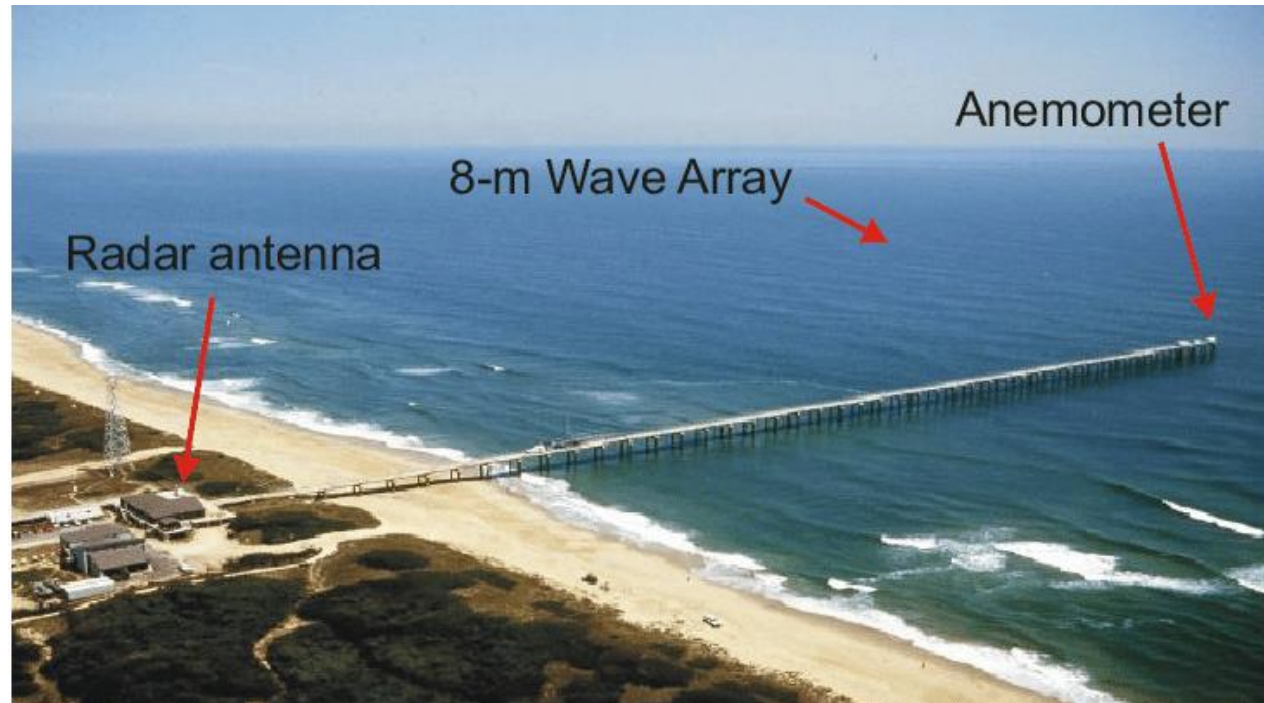
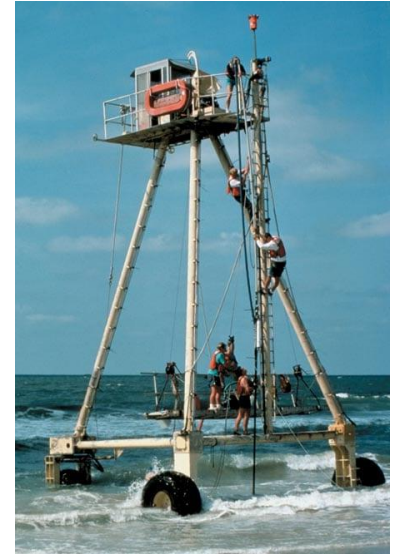
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Location

- The Field Research Facility (FRF) is located on the Atlantic Ocean in Duck, NC.
- Maintains a comprehensive, long-term monitoring program of the coastal ocean, including waves, tides, currents, local meteorology and the associated beach response



SwarmDivers

- Unmanned surface/undersea vehicle (USV/UUV) developed by Aquabotix
- Multiple vehicles are controlled simultaneously as a single coordinated entity
- Can dive up to 50m and provides wireless data feedback upon surfacing
- Currently a small fleet is in R&D stage at the FRF

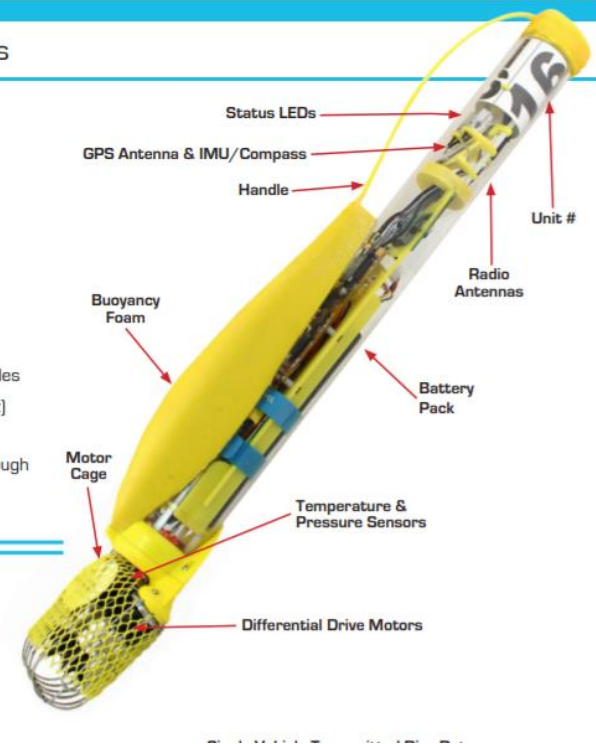
SwarmDiver Technical Specifications

Length	0.75m / 29.5"
Enclosure OD	57mm / 2.25"
Beam	0.13m / 5.1"
Draft	0.45m / 17.7"
Weight	1.7kg / 3.7lb
Dive Depth	50m / 164'
Propulsion	2x brushless DC motors
Speed	Up to 2.2m/s / 4.3knots
Endurance	Up to 2.5hours / 7km / 4.3miles
Communications	Dual radio (900MHz / 2.4 GHz)
Sensor Expansion*	2 x I2C 2 x SPI 2 x UART 1 x cable pass-through

*Additional customization options are available.

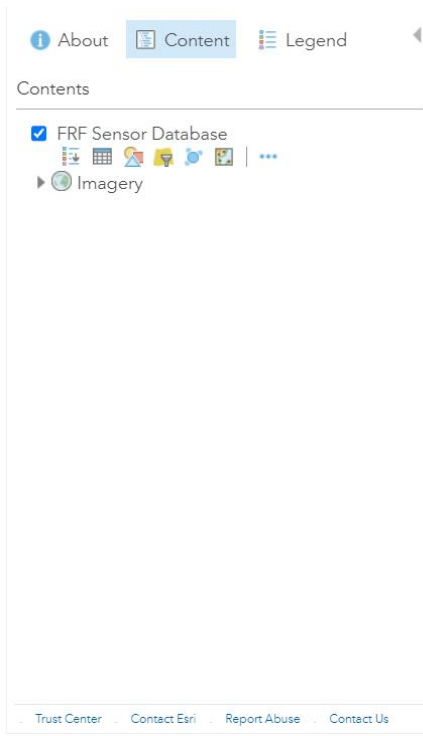
Applications

- Environmental Monitoring
- 3D Synoptic Data Gathering
- Plume Tracking
- Mobile Buoy Markers
- Autonomous Depth Sounding



Array

- Cross-shore array of wave and current measuring devices (shown below)
- SwarmDivers deployed from shore, sent to array, and dive the instrument to obtain depth measurements for comparison



Data

- Each diver logs its X,Y,Z position and orientation at 1 hz
- Data is written to CSV during mission
- Much of this data is unnecessary. We care about depth measurements on individual dives

A	B	C	D	E	F	G	H	I	J
vehicleID	time	lat	lon	depth_m	temp_C	groundSpe	yaw_deg	pitch_deg	roll_deg
604	2021-10-19 13:39:11Z	36.185383	-75.75198	0	18.137	0	79	0.2	23.6
604	2021-10-19 13:39:12Z	36.185375	-75.75199	0	18.128	0	79	0.2	23.6
604	2021-10-19 13:39:13Z	36.185371	-75.75199	0	18.12	0	79	0.2	23.6
604	2021-10-19 13:39:14Z	36.185368	-75.75199	0	18.111	0	79	0.2	23.6
604	2021-10-19 13:39:15Z	36.185368	-75.752	0	18.111	0	79	0.2	23.6
604	2021-10-19 13:39:16Z	36.185364	-75.752	0	18.094	0	79	0.2	23.6
604	2021-10-19 13:39:17Z	36.185364	-75.75201	0	18.094	0	79	0.2	23.6
604	2021-10-19 13:39:18Z	36.18536	-75.75201	0	18.077	0	79	0.2	23.6
604	2021-10-19 13:39:19Z	36.18536	-75.75201	0	18.059	0	79	0.2	23.6
604	2021-10-19 13:39:20Z	36.18536	-75.75201	0	18.042	0	79	0.2	23.6
604	2021-10-19 13:39:21Z	36.18536	-75.75201	0	18.025	0	79	0.2	23.6
604	2021-10-19 13:39:22Z	36.18536	-75.75201	0	18.025	0	79	0.2	23.6
604	2021-10-19 13:39:23Z	36.18536	-75.75201	0	18.016	0	79	0.2	23.6
604	2021-10-19 13:39:24Z	36.18536	-75.75202	0	18.008	0	79	0.2	23.6
604	2021-10-19 13:39:25Z	36.18536	-75.75202	0	17.999	0	79	0.2	23.6
604	2021-10-19 13:39:26Z	36.18536	-75.75202	0	17.982	0	79	0.2	23.6
604	2021-10-19 13:39:27Z	36.18536	-75.75202	0	17.964	0.1	79	0.2	23.6
604	2021-10-19 13:39:28Z	36.18536	-75.75202	0	17.956	0	79	0.2	23.6
604	2021-10-19 13:39:29Z	36.18536	-75.75202	0	17.956	0	79	0.2	23.6
604	2021-10-19 13:39:30Z	36.18536	-75.75202	0	17.956	0	79	0.2	23.6
604	2021-10-19 13:39:31Z	36.185352	-75.75202	0	17.947	0	79	0.2	23.6

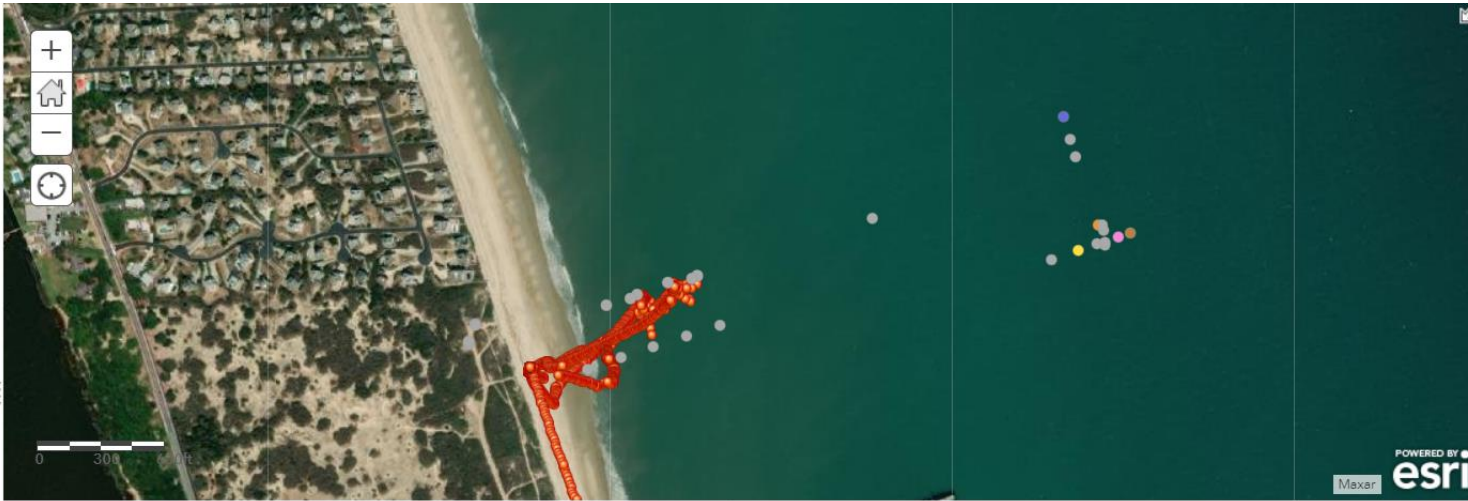
AboutContentLegend

Contents

FRF Sensor Database

swarm divers 604 10 19 2021 parsed

Imagery



swarm divers 604 10 19 2021 parsed (Features: 3581, Selected: 0)							
vehicleID	lat	lon	depth_m	temp_C	groundSpeed_m_p_s	yaw_deg	pitch_deg
604	36.19	-75.75	3.69	19.72	8.40	99.50	70.20
604	36.19	-75.75	3.72	19.72	8.40	118.70	76.20
604	36.19	-75.75	3.88	19.72	8.40	174.60	81.10
604	36.19	-75.75	3.69	19.72	8.40	196.60	81.60

Goal and Workflow

Goal: Create a Python tool to quickly process SwarmDiver data and create bathymetric surface

1. Parse CSV and separate Date/Time Column

```
1 def parseSwarmDiverDateTime(Input, Output):
2     import pandas as pd
3     df = pd.read_csv(Input)
4     df['date'] = pd.to_datetime(df['recordtime'], errors = 'coerce').dt.date
5     df['time'] = pd.to_datetime(df['recordtime'], errors = 'coerce').dt.time
6     df.drop('recordtime', axis = 1, inplace = True)
7     df.to_csv(Output, index = False)
8     print("done")
9
10 parseSwarmDiverDateTime('./swarm_divers_604_10-19-2021.csv', './swarm_divers_604_10-19-2021-parsed.csv')
```

done

2. Extract max depth obtained on each dive

Options I am currently exploring.

1. Query that uses time and depth
2. `scipy.signal.find_peaks`

3. Interpolate



Interpolate Points (Raster Analysis)

```
arcpy.ra.InterpolatePoints(inputPointFeatures,
interpolateField, outputName,)
```

Potential Difficulties

Difficulties extracting dive points (2 options)

1. Run 2 part Query using time and depth

- Requires log of dive times
- Requires more input from user

Ex. “For a given time period, return the maximum depth”

2. Find peaks tool

- Takes a 1-D array and finds all local maxima by comparison of neighboring values
- Returns indices of peaks in x that satisfy given conditions
- New to me and may be over complicated

