

AUV Data Analysis



MRRSS - 2016

Ryan N. Smith

Topics

- Data Types
- Data Format
- On Board/Off Board
- Data Transmission
- Time Delays
- Use in Deliberation
- Modeling

Data Types

Point measurement

- Data at a single point in space and time
- Rapid collection
- Small storage size

Range measurement Data covering a large spatial region Dense dataset Large storage size

Data Formats

- ASCII text
 CSV
 - Fixed-width
- Binary
- Images
- Video
- Point Cloud

Bag File (ROS)

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Bag File (ROS)

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chu-chu@play:~/catkin_ws/src/rpg_monocular_pose_estimator/monocular_pose_estimator\$ rostopic hz /camera/image_raw subscribed to [/camera/image_raw] average rate: 29.899 min: 0.027s max: 0.040s std dev: 0.00237s window: 29 average rate: 29.940 min: 0.027s max: 0.040s std dev: 0.00219s window: 59 average rate: 29.968 min: 0.027s max: 0.042s std dev: 0.00273s window: 89 average rate: 29.976 min: 0.027s max: 0.042s std dev: 0.00271s window: 119 average rate: 29.992 min: 0.027s max: 0.042s std dev: 0.00274s window: 148 ^Caverage rate: 29.960 min: 0.026s max: 0.042s std dev: 0.00289s window: 166 chu-chu@play:~/catkin_ws/src/rpg_monocular_pose_estimator/monocular_pose_estimator\$ rostopic hz /monocular_pose_estimator/image_with_detections subscribed to [/monocular_pose_estimator/image_with_detections] average rate: 0.259 min: 0.736s max: 6.986s std dev: 3.12526s window: 3 no new messages no new messages average rate: 0.303 min: 0.736s max: 6.986s std dev: 2.67027s window: 4 no new messages no new messages no new messages no new messages no new messages no new messages average rate: 0.338 min: 0.097s max: 7.303s std dev: 3.03129s window: 7 no new messages no new messages no new messages no new messages no new messages no new messages average rate: 0.290 min: 0.097s max: 7.303s std dev: 3.05029s window: 8

Sonar File (.sl2)

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EcoMapper Log File

Latitude; Longitude; Time; Date; Number of Sats; GPS Speed (Kn); GPS True Heading; GPS Magnetic Variation; HDOP; C Magnetic Heading; C True Heading; Pitch Angle; Roll Angle; C Inside Temp (c); DFS Depth (m); DTB Height (m); Total Water Column (m); Batt Percent; Power Watts;Watt-Hours;Batt Volts;Batt Ampers;Batt State;Time to Empty; Current Step; Dist To Next (m); Next Speed (kn); Vehicle Speed (kn); Motor Speed CMD; Next Heading; Next Long; Next Lat; Next Depth (m); Depth Goal (m); Vehicle State; Error State; Distance to Track (m); Fin Pitch R; Fin Pitch L; Pitch Goal; Fin Yaw T; Fin Yaw B; Yaw Goal; Fin Roll; DVL-Depth (m); DVL -Altitude (m); DVL -Water Column (m);DVL-FixType;DVL-FixQuality;DVL-Temperature;Conductivity (mmhos/cm); Temperature (c); Salinity (ppt); Sound Speed (m/s); Date m/d/y ;Time hh:mm:ss;Temp C;SpCond mS/cm;Sal ppt;Depth feet;pH;pH mV;Turbid+ NTU;Chl uq/L;BGA-PC cells/mL;ODOsat %;ODO mg/L;Battery volts; 37.290932;-107.844191;10:14:04.55;6/21/2016;11;0.074;123.91;9.46915788676373 ;0.83;26.3;38.6;3.01;-4;19.1;.01;1.77;1.78;91;20;550.8;16.1;-1.2;D;1822.4;0;2.978;2;0.02;128;200.27;-107.84420266;37.29090638;0;0;1;N;2.524606;76;76;11;250;250;158.56 77;0;9999.99;1.80;1.927;2;9;18.3;0;18.2000007629395;0.1;1476.7940 1;06/21/16;10:11:20;17.53;0.203;0.10;-7.438;8.25;-71.7;4.2;-2.0;-3103;86.3;8.25;12.5; 37.2909311666667;-107.844192;10:14:05.55;6/21/2016;11;0.063;123.91;9.46915788676373 ;0.83;26;38.29;2.91;-4;19.1;.01;1.77;1.78;91;20;550.8;16.1;-1.2;D;1822.4;0;3.031;2;0.02;128;199.9;-107.84420266;37.29090638;0;0;1;N;2.558844;74;74;11;250;250;158.75 82;0;9999.99;1.80;1.927;2;9;18.2;0;18.2999992370605;0.1;1477.1161 7;06/21/16;10:11:21;17.53;0.203;0.10;-7.442;8.26;-72.7;4.6;-1.2;-



Image File



On-Board vs. Off-Board

- Data transmission
- Time delays
- Use on deliberation
- Modeling

Data Transmission

Types:

- Acoustic
- Satellite
- Wi-Fi/Radio

Limitations:

- Distance
- Bandwidth/Transmission speed
- Cost

Time Delays

Acoustic up to 80 kbits per second

Satellite

~10 Megabits per second

Wi-Fi/Radio

-1 Gigabits per second

Time Delays

Limitations:

- Acoustic
 - □ 2 km
- Wi-Fi/Radio

 Line of sight
 20 km

Use in Deliberation

Data processing

- On Board
 - 2-3 second delay
- Off Board

Days to weeks in some cases

Data Processing

- Point Data
- Range Data
 - Visualization
 - Usability
 - Complexity

Data Visualization





Final Products



Modeling

- Use of data
- Inform future sampling
- Predict where to be and what to sample

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(a) Theoretical model of an ocean front, assuming that each SST observation $z^{(i)}$ is drawn from a normal distribution. See [91] for details.



(b) A window of satellite image data aligned approximately along the Southland Front off the east coast of South Island, New Zealand. Image extracted from AVHRRSST data.



Exercise

Exercise:

Describe effective methods of processing and visualizing the following types of data:

- Vision
- GPS
- Water quality (%Chlorophyll, pH, ORP, Turbidity, etc.)
- Radio beacon
- Inertial Measurement Unit (IMU)
- Compass
- □ Gyro
- LiDAR (Light Distance And Ranging)
- Radar
- Doppler Velocity Log (DVL)
- Sonar
- Acoustic