

Dorado AUV Survey Design for the September 2012 CANON Experiment

(Revised on 4 September 2012)

Yanwu Zhang, John Ryan, Hans Thomas, and Jordan Stanway

Dorado AUV objectives:

- 1) Conducting yo-yo transects around the ESP drifter (ESP at 10 m depth) using the Dorado's augmented sensing capabilities, to provide environmental data for ESP.
- 2) Also transecting through "history water" marked by the Stella drifters (drogue at 10 m depth).

Timeline:

Day 1 (09/10): R/V Zephyr (with Dorado AUV on deck) transits to experiment area.

Day 2 (09/11): See Fig. 1: Dorado yo-yos on the sides of a triangle in an attempt to enclose the drifting track of the ESP. Since only Stella #1 is in water, Dorado does not track "history water" yet.

Algorithm of calculating the lat/lon of the three vertices of the equilateral triangle (i.e., Dorado's three waypoints) is shown in Fig. 1, and explained as follows. **The MATLAB script for computation is attached separately.**

- Size of the equilateral triangle. The distance from the triangle's center to side is 3 km. The length of each side is $(3 \text{ km} / \tan(30^\circ)) * 2 = 10.4 \text{ km}$. The total length of one lap is 31.2 km.
- Dorado runs on the triangle in an attempt to enclose the ESP's drifting track. Over the duration of Dorado's completing one (or two) laps of the triangle, ESP correspondingly drifts over some distance, as shown by the red line in Fig. 1. For example, assuming Dorado's horizontal component of speed = 1.1 m/s, and ESP drifting speed = 0.2 m/s. Then it will take Dorado $[31.2 \text{ km} / (1.1 \text{ m/s})] = 7.9 \text{ hours}$ to complete one lap; over this duration, ESP will be traveling a distance of $(0.2 \text{ m/s}) * 7.9 \text{ hours} = 5.7 \text{ km}$.

Note:

Total travel time of ESP drifter (i.e., the red line in Fig. 1)

= Dorado's transit time (to the first vertex of the triangle) + Dorado's travel time on the triangle

- The pointing direction of the triangle is aligned with the ESP's drifting direction. The center of the triangle is set as the one-third point of the ESP's drifting track. (Note that if the red line extends from the base side all the way up to the vertex, the triangular center will lie at the one-third point.)

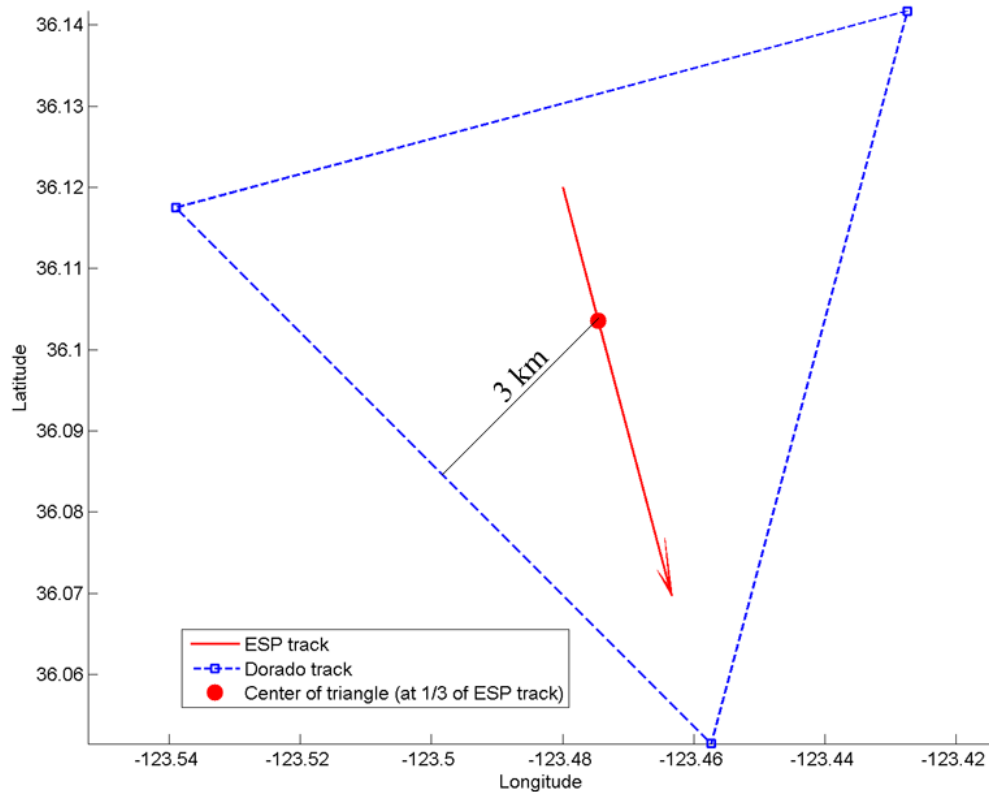


Figure 1. Dorado AUV’s triangular track that attempts to enclose ESP’s drifting track (without considering the Stella drifters’ locations).

Day 3 (09/12): See Fig. 2.

Dorado yo-yos through “history water” (i.e., a line defined by locations of Stella #1 & #2), followed by the triangular yo-yo transect.

Note 1:

Total travel time of ESP drifter (i.e., the red line in Figure 2)

= Dorado’s transit time (trailing through Stella #1 & #2’s historical locations) + Dorado’s travel time on the triangle

Note 2:

Dorado flies on the triangle in the Earth frame, while the LRAUVs circle around the ESP drifter in the Lagrangian frame. Thus the LRAUVs’ track appears as spirals in the Earth frame.

Day 4 (09/13): See Fig. 2.

The Dorado AUV yo-yos through “history water” (i.e., a line defined by locations of Stella #1, #2 & #3), followed by the triangular yo-yo transect.

Day 5 (09/14): R/V Zephyr (with Dorado AUV on deck) transits back to MBARI.

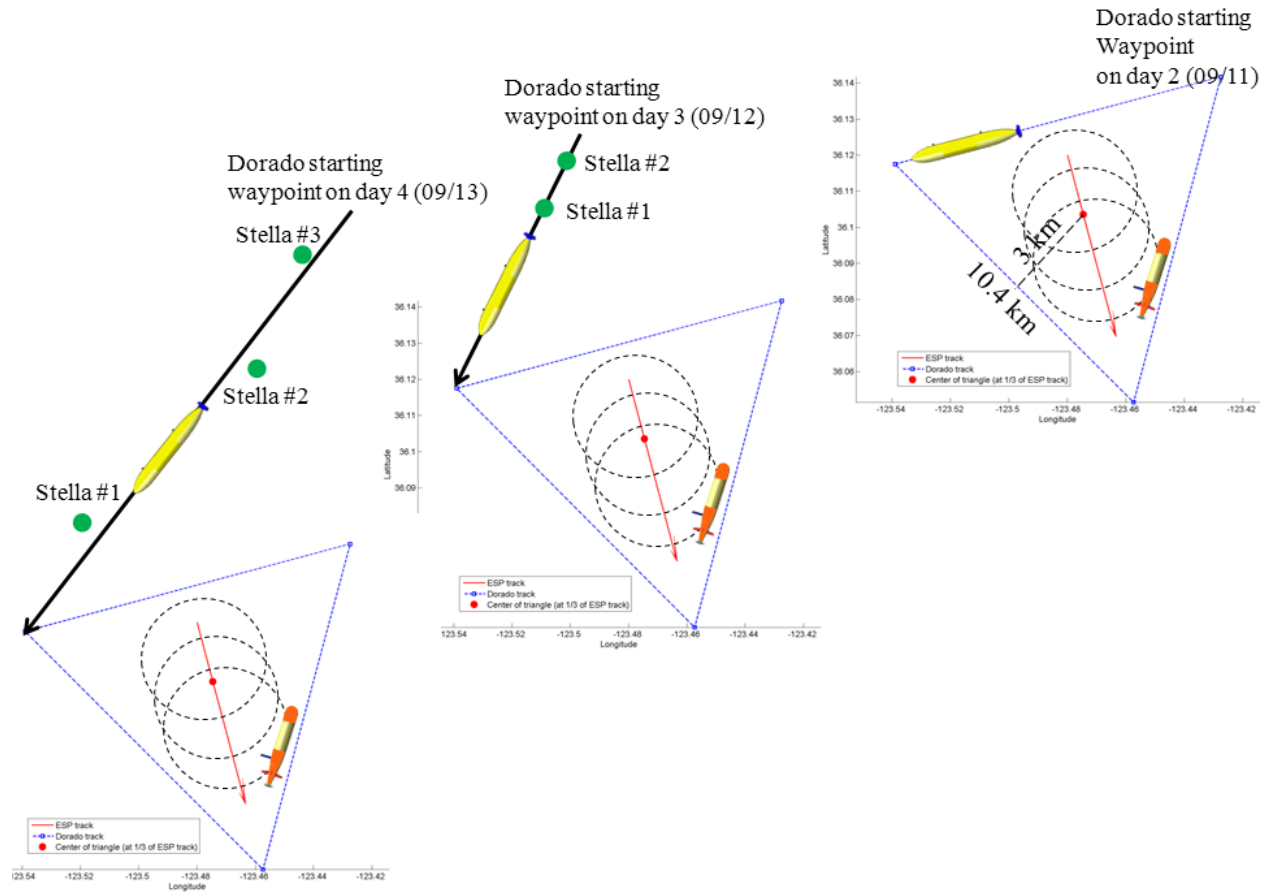


Figure 2. Dorado AUV transects through “history water” (i.e., a line defined by locations of Stella #1, #2 & #3), followed by the triangular track.