

“The Physics of Sailing” Post-Lesson Assessment: Sail Simulator Tutorial

Resource: <http://www.northsails.com/sail-trim-sim/>

Terminology

VMG: “velocity made good” – a component of the velocity in the direction of your destination. In the sail simulator, this is represented as a percentage – this means it is a measure of how good your course/speed actually is, compared to what it would be under perfect conditions.

Heel: The amount of rotation about the boat’s longitudinal axis

Rudder: The amount of rudder angle needed to maintain a straight line. If the boat is perfectly balanced, this would be 0 degrees.

Leeway: The degree to which the boat is sailing off of its intended track.

Main Upper/Middle/Lower: the top, middle, and bottom thirds of the main sail

Mainsheet: adjusts position of main (largest) sail

Backstay: attaches from top of the mast (vertical pole) to the back of the boat, adjusting the mast position.

Traveler: attaches from the boom (horizontal pole) to the back of the boat, adjusting the boom position.

Luff Tension: measures the amount of tension along the edge of the sail that is attached to the mast

Note: not all terminology that you will find on the control panel is defined here. Through this activity we will try and figure out what some of these other terms mean!

Before you begin: make sure the control module on the bottom left is toggled to the “Main” option and not the “Jib” option. The main sail is the large sail supported by the mast and boom, the vertical and horizontal poles, while the jib sail is the smaller sail at the front of the boat. While you are free to experiment with the jib sail controls as well, in this assignment we will focus on the main sail.

1. Adjust the “Mainsheet” control so that it is as tight as possible and as loose as possible.
 - a. What amount of mainsheet maximizes speed?
 - b. What is the relationship between the amount of mainsheet and the amount of heel and rudder angle?
 - c. Describe qualitatively what happens to the shape of the sail as the mainsheet is adjusted. To look at the shape of the sail from different angles, toggle the point of view using the eye-shaped

icon to the right of the control panel to view the sail from below, above, behind, or from the front.

2. Repeat the above exercise for the Backstay, Traveler, and Luff Tension controls.
3. Take a look at the display panel 2nd from the top right that displays the amount of “Draft,” “Camber,” and “Twist.” Adjust the four main controls (change viewing angle if necessary) and observe the following:
 - a. Which of the four controls have a significant affect on the “Draft”? What do you think the “Draft” is measuring?
 - b. Repeat for “Camber” and “Twist.”
4. Make note of any other relationships you see between the independent variables (your sail controls) and the dependent variables (VMG, draft, leeway, etc.). For example – does a deeper draft cause the boat to heel more? Does the amount of backstay affect the rudder angle?
5. Now that we have a general idea of how the sail shape changes when we adjust each of the four controls, toggle the controls in order to maximize the VMG.
 - a. Tip: to reset your controls, either refresh the page or reset all controls back to the middle value.
 - b. Trick: if you get stuck, click the “magic wand” icon above the point-of-view button. This will automatically optimize the controls. If you do this, make note of how these optimized settings are different from what you expected.
6. Challenge: use the top right control bar to change the amount of wind. Repeat the above steps for wind speeds of 6.0 kts and 16.0 kts.
 - a. Trick: Optimize the sail settings for 6.0 kts, and for 16.0 kts. Compare how the sail settings are different for different wind speeds.