

## On-the-Water Challenges

Basic Challenges can be done in Semi-autonomous mode (manual control of rudder, automatic sail) which is easier and is very useful when learning to code and learning how the boat behaves.

### Basic Maneuvers that need only a Wind direction sensor:

#### 1. Turn to a given point of sail and sail it

Choose a desired point of sail (angle of windvane). Start boat at some point of sail, turn to the desired point of sail within a given amount of time, and continue on that course. Points of sail: Close haul =  $\pm 45^\circ$ , beam reach =  $\pm 90^\circ$ , Broad reach =  $\pm 135^\circ$ , etc.

#### 2. Get out of irons

Start boat in irons (bow facing the wind). Get out of irons within a given amount of time, continue on desired point of sail.

#### 3. Tack turn: bow turns through the wind

Choose a desired point of sail. Start boat on a course that is not the desired point of sail. Sail such that it has to tack to get to the desired point of sail.

#### 4. Jibe turn: stern turns through wind

Choose a desired point of sail. Start boat on a course that is not the desired point of sail. Sail such that it has to jibe to get to the desired point of sail.

#### 5. Tacking 180° (side to side course)

Sail a beam reach for some amount of time, tack, and sail the opposite beam reach, tack back, repeat. Make sure the turns are all tacks (bow through the wind).

#### 6. Jibing 180° (side to side course)

Sail a beam reach for some amount of time, jibe, and sail the opposite beam reach, jibe back, repeat. Make sure the turns are all jibes (stern through the wind).

#### 7. Beating-upwind course –

Sail an upwind course that requires the boat to sail for a given amount of time, tack, sail, tack... Make sure the boat doesn't go so far away that you cannot retrieve it.

#### 8. Run-downwind course –

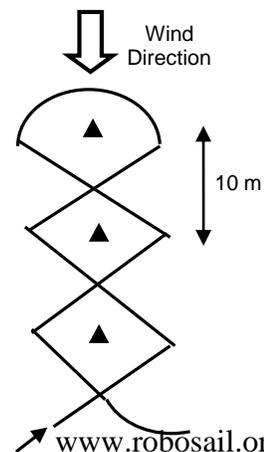
Sail an upwind course that requires the boat to sail for a given amount of time, jibe, sail, jibe... Make sure the boat doesn't go so far away that you cannot retrieve it.

#### 9. Sail a 20 meter circle/diamond

Plan a course that returns to its start position using tacks and jibes as needed. Use timing to set the distance sailed between each turn.

#### 10. CBI Helmsman Test

Boats will sail a course similar to the course that CBI Adult and Junior members sail to earn their Helmsman/Yellow Rating. The course includes 3 buoys in a windward-leeward line, spaced approximately 10 meters apart. Boats start below the leeward mark and sail upwind performing 3 tacks around the buoys, round the windward mark and sail downwind performing 3 jibes around the buoys and finishing below the leeward mark.



## Advanced Maneuvers done in Full-Autonomous mode

### Maneuvers that need a Wind direction sensor and a Compass

#### 11. Sail at compass angle

Sail at a given heading. The heading should be "absolute" (defined by a compass. Note that headings are defined as East as 0°, North is 90°, West is 180°, South is 270°.

#### 12. Sail a course defined by several compass angles. compass angle with tack/jibe

Sail a course defined by several given headings with turns between them specified as tacks or jibes. The headings should be "absolute" (defined by a compass. Note that for RoboSail we define East as 0°, North is 90°, West is 180°, South is 270°.

### Maneuvers that need a Wind direction sensor and a GPS

#### 13. Sail a given distance

Start at a given point. Sail a desired distance away, then sail back to the start, or stop (get into irons).

#### 14. Sail a course defined by several distances

Start at a given point. Sail a desired distance away, then onto another defined point, etc.

### Maneuvers that require at least a Wind direction sensor, a Compass, and GPS

#### 15. Station keeping course –

Sail into a 20 m x 20 m "box" formed by four buoys with known GPS locations. The boats should to remain in the box for a given amount of time, then exit the box.

#### 16. Sail through Finish Line

Sail through a finish line determined by GPS coordinates from a given starting position that is approximately 20 meters away.

#### 17. Sail to WayPoint

Sail to within 3 meters of a waypoint from a given starting position that is approximately 20 meters away.

#### 18. Sail to a series of WayPoints

Sail to within 3 meters of each of a series of waypoints.