Navigation & Missions Workshop Hands-On Exercises – June 2019

Goals:
• Get the added experience of Navigation & Mission Planning with the LEGO® EV3. State Championship Tournament videos reveal a number of teams lacking in basic navigation and mission planning skills. Workshop 3 will help coaches and teams master these skills.

Before starting workshop:
• Show State Championship video, FLL Oregon CT 1-10-16-HD.mp4, show at beginning of workshop. Stop video at beginning 2 seconds, point out referees, teams on left ready to start, team on right discussing run with referee. Team lower left getting robot inspected on deck before competition. Restart video and turn up audio to show teams completing missions.

Process:
• Form group into teams, try to have one experienced person on each team. Encourage team discussion, ask lots of questions of the teams, try to keep it very hands-on and interactive.
• Going Straight, show video CT14-SearchEngine.mp4. This video shows the robot doing moves and turns, to the Search Engine mission. Fork misses the search engine loop. Review video points slide 5. Rerun video and point out problems.
• Slides 6,7: Lab exercise going straight. Shows how the robot drifts from side to side. Introduces the concept of an error zone each time the robot moves. Tape two 8.5 x 11 white pages about 2 feet apart (for each team). Have teams carefully mark robot starting points, front tires (front to back error) and back ball (side to side error). Optionally add Axle Marker to front of robot, see photo in slide 6. Program robot to run straight, 3-4 times at each speed. Mark landing points, use Axle Marker or corner of color sensor. Class discussion, what errors seen by each team? Slide 7 use to record Going Straight data.
• Slides 8,9: Lab exercise, using Color Sensor to show overshoot. Place a piece of black or blue tape on white page for each team. Program color sensor to stop on black or blue line. Program using Color mode. More on color sensor in later slide. Note three different speeds shows more overshoot with higher speeds. Class discussion of overshoot.
• Slides 10, 11 Waypoint and Error Zones, teams back home record error zones and overshoot data, to help them internalize error zone concepts.
• Background, slide 12, table scores data from ORTOP state championship, supports goal of moving lower teams up into middle of pack. What are navigation differences between low scoring teams and high scoring teams? This workshop will go over these skills in detail.

• Navigation skill problems, and best practices, slide 13

• Teams can also use fixtures, slide 14, for navigation and to overcome error zones.

• Slide 15, Lab exercise, establishing Waypoints. Plan a short mission using waypoints to Missions M01 & M10. Plan robot moves and turns using various tools such as wall bump, find a line, etc. This is a writing exercise, programming will come next. Slide 16 is larger view for mission planning exercise.

• Introduce Mission Planning template slide 17, then return to slide 16 so teams can see Food mission.

• Color sensor, Reflected Light mode vs. Color mode (slide 18). Hand out color gradient and color block pages to each team. Lab, Open ColorGradient50.ev3 program. Start at white end of gradients G, B, & R. Run the program, mark (in front of light sensor) where the robot stops. Note it does not stop on red line. Why? Because red line is not saturated enough to give 50% reflected color. This may show up on competition mats. Note: Color Mode does not replace Reflected Light mode, depends on the situation. Also, don't trust your eyes, use Port View.

• Color Sensor, Port View, using color blocks page, show students how to use port view (refresh from previous workshops). Hold sensor over various colors and note reflected light. Show students how to change to Color mode, record Port View data from various colors. Use Show Context Help for more info on Color Sensor programming. In judging, we see a lot of teams give up on the Color Sensor. These exercises should help them learn more, so they can use it as a navigation tool.

• Turning, slides 19 & 20, using one wheel and two wheels. Class discussion on when to use each.

• Lab, Program a line follower, slide 21 describes the mission. Have teams write out what they want the robot to do. Instructor proceed to slide 22 & 23.

• Introduce Line Follower concepts (slides 22 & 23). Method: Parallel Programs, using Move Turn motor block, a Loop block, and a Loop Interrupt block. Program top section with Color Sensor to move on and off edge of line. Program bottom section to Interrupt the Loop when 3 second timer is complete. Don't give teams the solution, ask questions at the group level, then let teams proceed. Visit teams and ask appropriate questions.

• Optional, if an advanced team is interested, introduce Switch to move on and off line (slide 24). Program switch to sense when Color Sensor sees line. Place the switch inside of a loop. Use Loop to detect 3 seconds to end the program.

• Navigation skills video, slide 25. Stafford GEARs team. Narrate this video showing: find a line, bump the wall, follow a line, find a line, follow the wall back to base. Note how simple this robot is, using several way points on several missions.
• Programming help, slide 26. Show how to Help, Show Context Help to get more info on each programming block.

• Memory browser slide 27, show how to find out how much memory used for programs on the EV3.

• Space Travel & Food Production missions slides 29 & 30. Have teams program this mission using their mission plan from earlier in the workshop. Beginning teams may simply move the robot to in front of Space Travel, then use the tool motor to lift the mission. Advanced teams may use several waypoints move M10 to Green. Slide 30 is an example of move from base to point1.

• Summary slide: Identify routes and plan Way Points. Identify Error Zones. Use Navigation tools such as alignment blocks in base, find a line, wall bump, etc. The robot knows where it is on the mission field. Good Luck!


• M10 example, show this as needed. Three more moves to get in front of M10 and move the bar to green.