FTA's Best Practices

The Bionic Tigers - FTC 10464

modified from Ohio Kickoff presentation 2019

HOW TO KEEP YOUR ROBOT RUNNING ROUND AFTER ROUND

Common Causes of Robot Misbehavior

- Electrical connections
- Loose USB connections / damaged USB connectors
- Battery power
- Physical contact
- Wi-Fi Issues
- Game Controllers

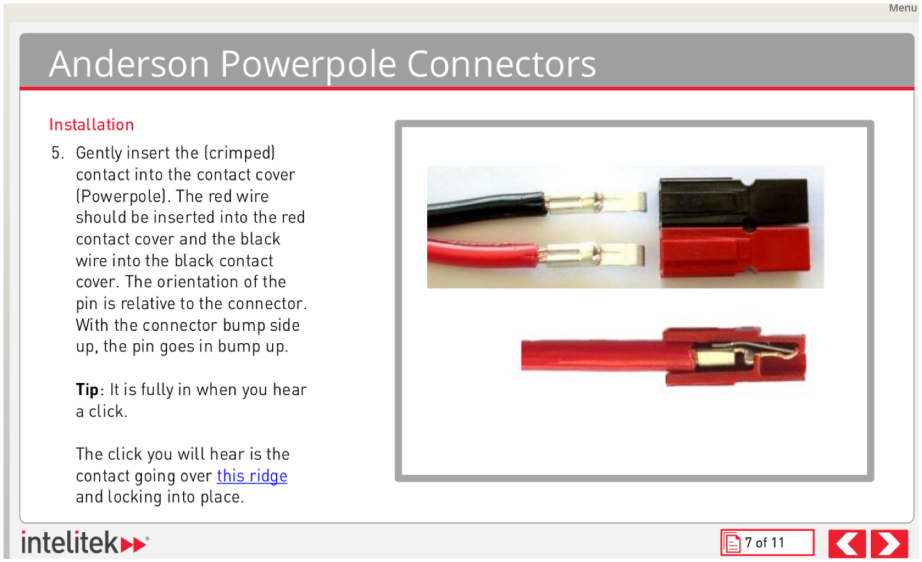
Common Team Misconceptions

- "There's nothing we can do"
  - Even with more-or-less unavoidable issues like static electricity, there are preventative measures to reduce the impact
  - Teams that take responsibility for issues and think "what did we do wrong" or "what could we improve" will end up with the most robust robots
- Underestimating the magnitude of physical contact
  - FTC is a full contact sport! Fragile robots will be at a disadvantage. Robustinate!

Fixing and Preventing Problems

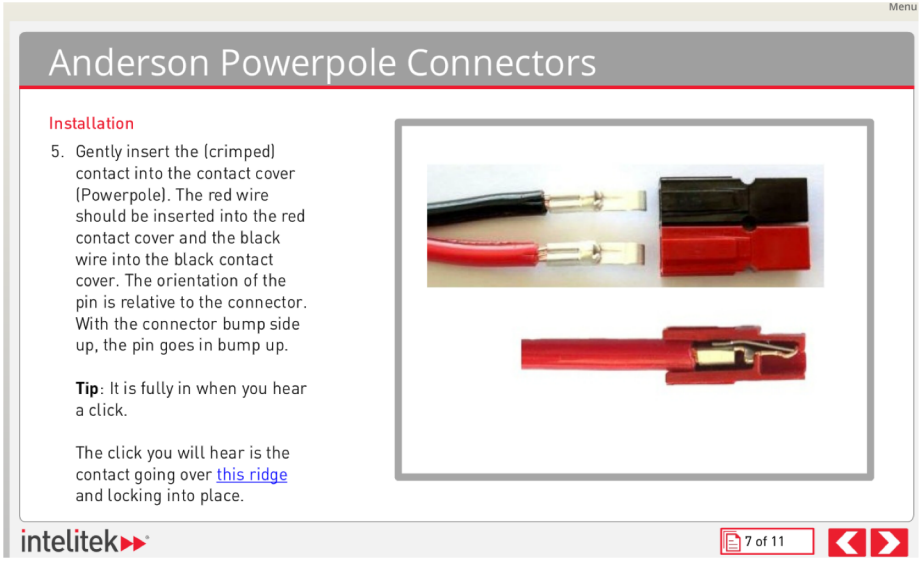
Electrical Connections

- Before each round or as often as is feasible, double check all of the electrical connections
  - Battery connector
  - USB cables
  - CORE Module Power Poles
  - Power Switch
- Design cable holders to reinforce USB connections and prevent wiggling or strain
- It may help to utilize rubber bands, zip ties or other materials to physically pull the cable into the hub



Electrical Connections

- Phase out Tamiya connectors in favor of Anderson Powerpoles
  - Tamiya connectors the point of failure numerous times – the connection gradually becomes loose over time
    - Intelitek has a nice tutorial about how to attach Anderson Power Pole connectors
    - Be aware that replacing the cable on the PDM will void the warranty – consider using an adapter
- Avoid excessively long cables
  - Especially motor/servo controllers



USB Disconnects

- A common cause of robot issues is USB connections
- After many disconnects and reconnects, USB connectors bend or become loose
- Robot motion can wiggle cables and cause temporary or permanent disconnects
- Impacts with robots, walls, or game elements can temporarily disconnect the USB cables, and the interruption can cause the robot to stop responding
- Solutions:
  - Use right-angle cables, fasten to the robot i.e. with rubber bands
  - Carry several spare cables (cheap from Monoprice!)
  - When available, use ADB over WiFi to avoid extra connects and disconnects
  - Updates to FTC SDK have improved reliability of USB communications and improved reactions to ESD events.

Battery Power

- Low robot batteries can lead to sluggish movement, or failure to move at all
- It's always a good idea to keep your batteries as charged as possible, though this can be difficult with tight match schedules
- Keep one or more spare, fully charged batteries on hand
- Remember – if you've just done 10 test runs of your robot on a practice field right before your next match, your batteries are probably going to be low!
- There may be issues with trying to configure the Robot Controller if the battery is below a certain voltage
- Make sure both of your phones are both charged as well – invest in some higher amperage chargers

More Tips

- Don't place Phone in the middle of your robot
  - Place it up high and out of the way of metal
  - Make sure screen with Robot Controller app is visible
- Reduce wireless noise coupled through USB cables– try a Ferrite Choke
  - Can buy for a few bucks at Radio Shack or other, not out of business retailers
  - Snaps on to the start and end USB cable
- Also look at USB Surge protectors to protect from static

Static Electricity

- Be very conscious of using omniwheels–generates charge rapidly
- Be smart when using plexiglass – great for isolating electronics from the metal frame, but large quantities collects charge
- Avoid spinning plastic devices in general, e.g. the infamous zip tie brush
  - Basically just attaching a Van De Graff generator to your robot…
  - Avoid extra-long USB cables, and avoid wrapping around the frame
  - Don't run USB cables next to power cables
  - Use quality, shielded cables
- Isolate electronics from the metal frame
  - Prevents static from contact with the frame from entering delicate electronics
- Use plenty of Ferrite Chokes!
- Be especially careful when using legacy motor and servo controllers – prone to the same lockups we've seen with the past tech

Physical Contact

- Ensure that your robot is not easily damaged by impacts with other robots
- Consider that, based on the game, there can be various robot arms occupying the airspace around your bot
- Minimize the possibility of wires being ensnared by other bots
- Consider a screen protector for phone

Wi-Fi Interference

- Make sure your phones have the cell radios disabled
- Turn off bluetooth
- Encourage your friends and family to avoid using mobile WiFi hotspots at the tournament
- If you bring a router for some odd reason, make sure the signal does not leak into the tournament area
- If many teams / robots are trying to connect to each other simultaneously, it can be difficult to pair. Try pairing in an area isolated from other robots

Game Controllers

- Every once in a while, a game controller actually does stop working correctly – bring spares
- Many other times, the real problem lies elsewhere
  - Latency – Heavy Wi-Fi traffic
  - Mis-mapped controller 1 v 2 (Start + A = 1, Start + B = 2)
    - Legacy controllers (Logitech Dual Action): Start + X/Y to map
- ZTE Speed phones are known to occasionally stop communicating with gamepads – only solution is restarting the phone
- The Moto G may have issues powering two controllers through a hub – can use battery hub

Other Good Practices

Robot Construction

- Use the latest electronics
  - The Modern Robotics modules are generally more robust than the older Hi-Technic motor and servo controllers
- Label your electronics modules by their serial numbers for easy troubleshooting
- Make your power switch incredibly obvious to spot
  - Colorful arrows, flashing LEDs, raised section of the robot, etc…
    - However, be careful to reduce the chance of another robot or a falling game element accidentally pressing the switch (this has happened several times)
  - If you bury your power switch inside your robot, the inspector is going to give you a dirty look in inspections…. And then make you move it.
- Manage cables and wires to prevent them from being hooked by another bot
- Avoid heavy use of LEGO parts (sensors are OK)
  - LEGO parts are much more fragile.
  - Compliment with Tetrix parts for strength
- Make sure your Robot Controller screen is visible
  - But don't expose it to unnecessary danger of impact from other robots

Robot Construction

- Try to electrically isolate the modern robotics modules from metal or loose wires as much as possible
- Static conducted through the frame may find its way directly to the modules, or through wires
- It is a bad idea to wrap ANY wires around the robot frame – keep them only as long as they need to be, and try to insulate from the frame
- Ideally, your cables should be off frame (perhaps in a plastic cable sleeve), and the modules should be mounted against an insulator such as wood or a wood substrate, or PVC type-A
- Avoid mounting on plexiglass or plastic sheets, as they are charge sponges
- Feasibility may vary by game challenge, but try to avoid charge-generating robot attachments such as plastic zip tie sweepers mounted on a metal axle
    - Omni wheels can also contribute to this problem if used in large quantities

Robot Programming

- Make use of the telemetry data return to debug potential issues
- If you drop in replace one of the Core modules, you need to redo the configuration
  - Each piece of hardware is identified by its serial number, which is checked by the config file. Different serial number = won't work with different hardware
  - Hardware swap feature. Makes it easy to replace electronics.
- Keep checking the FIRST GitHub and Technology forum for new SDK releases – the latest alpha or beta builds are usually made to solve the most commonly reported issues
  - You should try and make it as easy as possible to test new SDKs while also ensuring that the stable version is maintained in case of unexpected failure, for example using version control, multiple folders / laptops, or multiple robot controllers with a different version on each

Robot Programming

- If using a linear op mode (sequential commands), ensure that any loops are interruptible. This can be done by inserting a check for Opmode isActive in the loop conditions (quit loop if opmode not active)
- Also ensure that waiting periods use sleep, which is interruptible.
- For robots that use high draw or many motors, especially if many motors will be running simultaneously – be considerate of the method by which motor controllers set the motor power
  - Speed target: will crank up voltage to try and hit a specified speed when resistance is encountered (e.g. wall, slope, other robots…)
    - Can lead to a current spike, and thus a voltage drop, which can brownout the Modern Robotics modules and cause the robot to drop connection
  - Voltage target: does not change load even if motor encounters resistance

Be Prepared

- If you can afford it, get a few extras of crucial parts, including:
  - Tetrix batteries
  - A robot controller
  - A spare gamepad
  - Spare USB cables (both mini connectors for the modules to the core power distribution module, and the mini-micro chain for the robot controller)
  - A spare unpowered USB hub, if you use two gamepads
  - Modern robotics modules, especially the core power distribution module

  - Even if you never need your spares, you might be able to make the difference for another team having a really bad day

Extra Precautions

- Between matches, as much as possible, try to:
  - Make sure the robot has a fresh Tetrix battery
  - Restart your phones (ESPECIALLY ZTE Speeds!) and pair them to the RC before arriving at the field
    - Can mitigate gamepad connection problems
  - If you are really paranoid about static and it's extra dry, try bringing dryer sheets and giving your robot a wipedown
  - If only slightly paranoid, touch metal on the robot to the metal of the field walls to discharge / neutralize the charge on the robot before the match

WHEN IN DOUBT....

- Ask a veteran team!
  - Most experienced teams are more than happy to help out
  - Less dead robots means more fun for everyone
- Use FIRST's resources
  - https://www.firstinspires.org/resource-library/ftc/technology-information-and-resources
  - https://www.firstinspires.org/resource-library/ftc/robot-building-resources
- Check the forums and ask questions
  - http://ftcforum.usfirst.org/forumdisplay.php?156-FTC-Technology
- Check the GitHub documentation and tutorials
  - https://github.com/ftctechnh/ftc_app/tree/master/doc/tutorial
  - https://github.com/ftctechnh/ftc_app/wiki

Dealing with Static

- Be sure to check the latest rules and FAQ posts to determine legal parts! E.g., dragging chains/wires and copper tape have been outlawed due to creating more problems for teams without the preventative measures.
- See Tom Eng's stickied post on the FTC Technology Forum:
- http://ftcforum.usfirst.org/showthread.php?6128-Electro-Static-Discharge-Mitigation&s=d18780fbd3b1e75aea2ae4a6faf6fe24

Credits

- This lesson was written by The Bionic Tigers 10464 for FTCTutorials.com
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