Robot Electronics

StuySplash – Dec 15 2012
Samuel Lijin, Director Emeritus of Electronics FRC694
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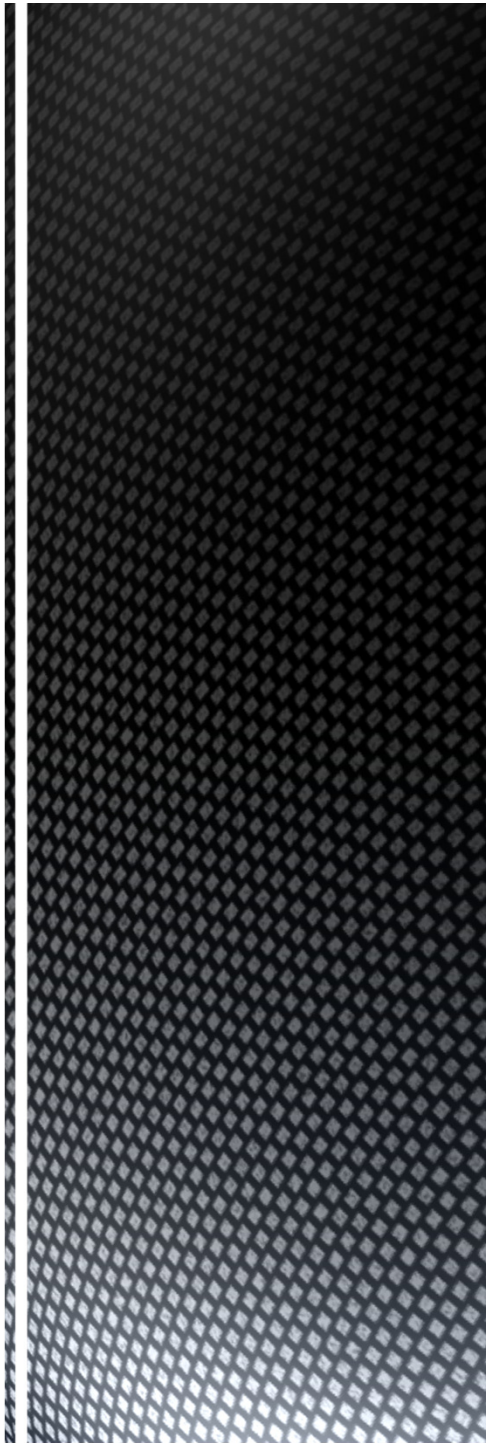
Chief Delphi: slijin



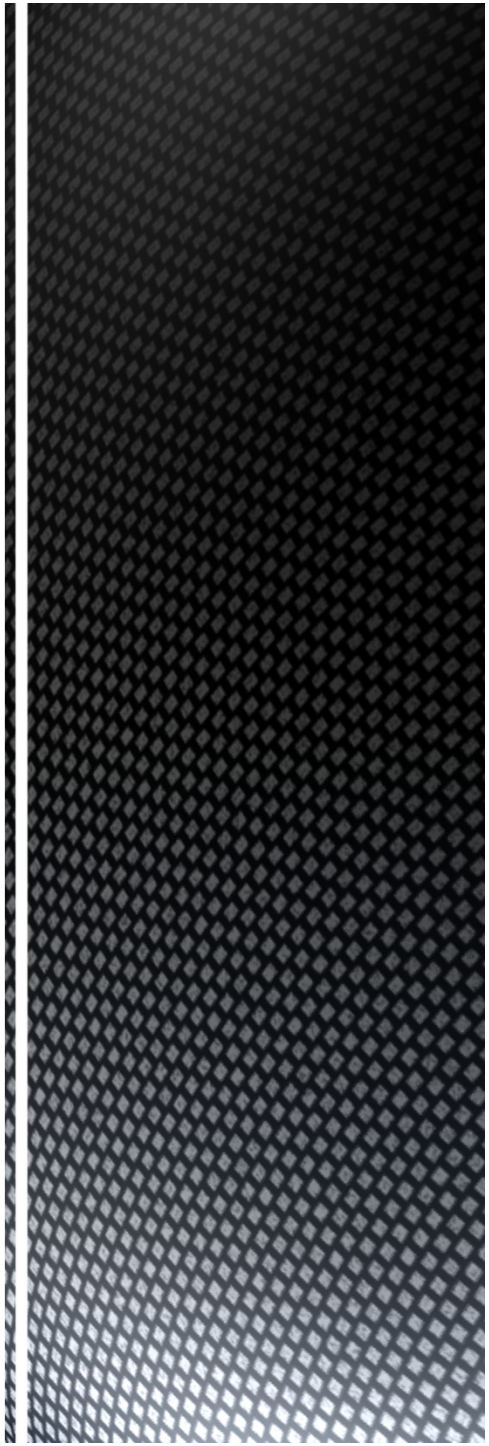
Overview

Troubleshooting your control system

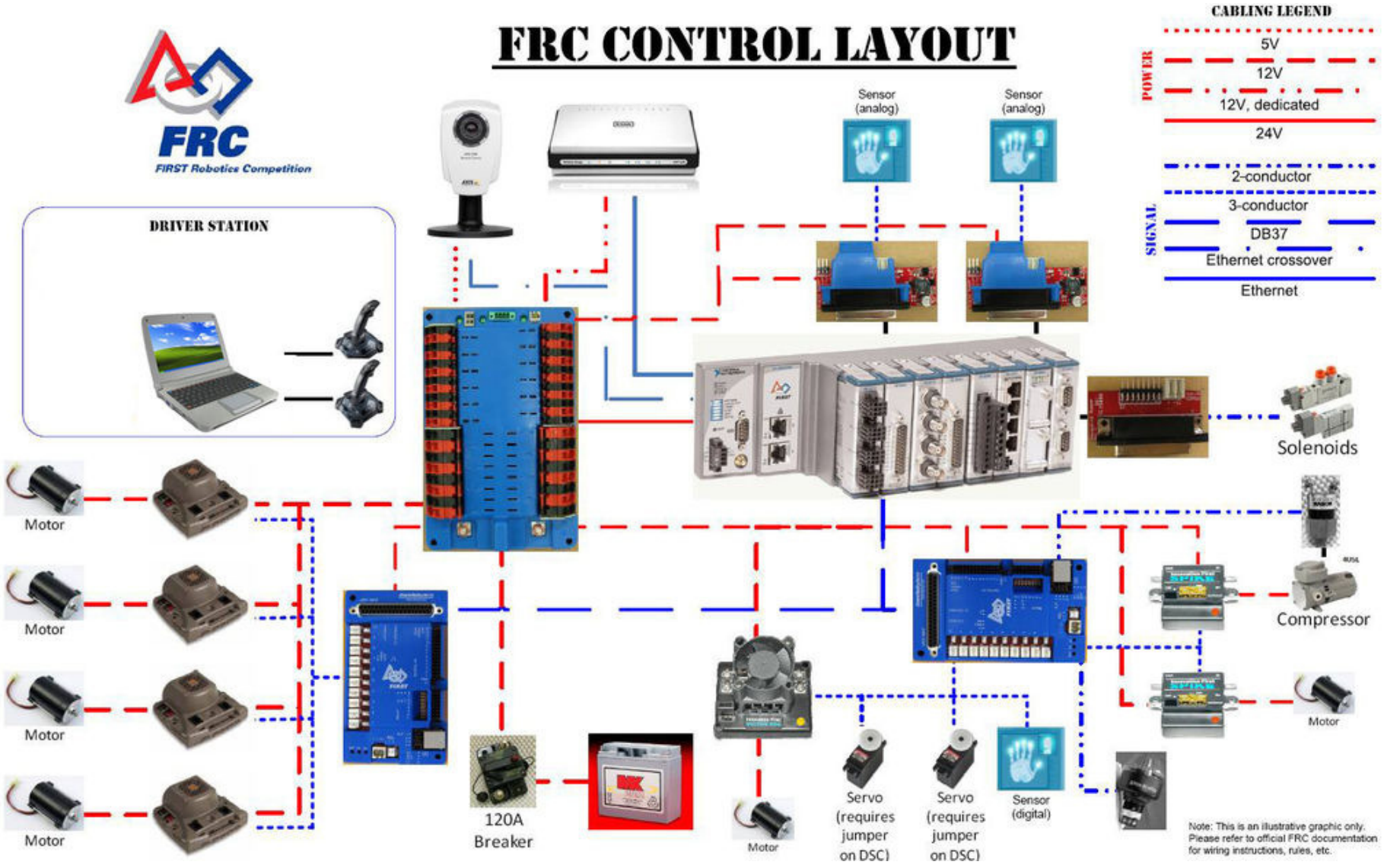
Good wiring practices

Recommended tools

What's new in 2013 & why it matters



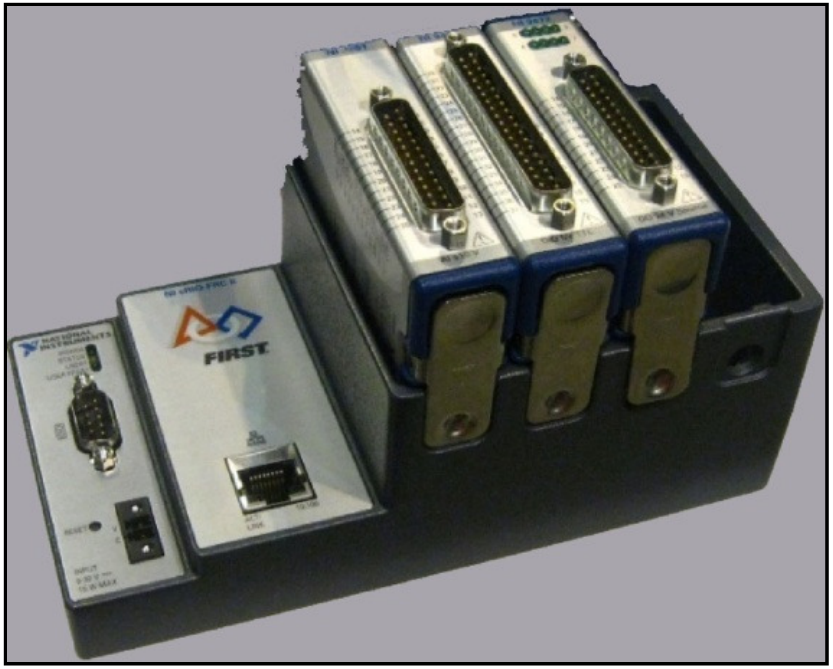
DISCLAIMER: This diagram is not up to date. Please do not use this as a reference guide.

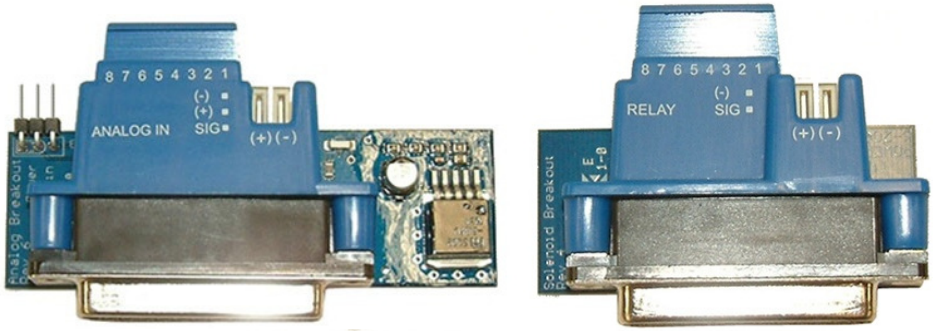


Source: http://www.instructables.com/id/Control-System-Basics/?ALLSTEPS

the nerve centers

common problems:
not using the dedicated outputs
plugging something in backwards
ignoring the lights





Troubleshooting

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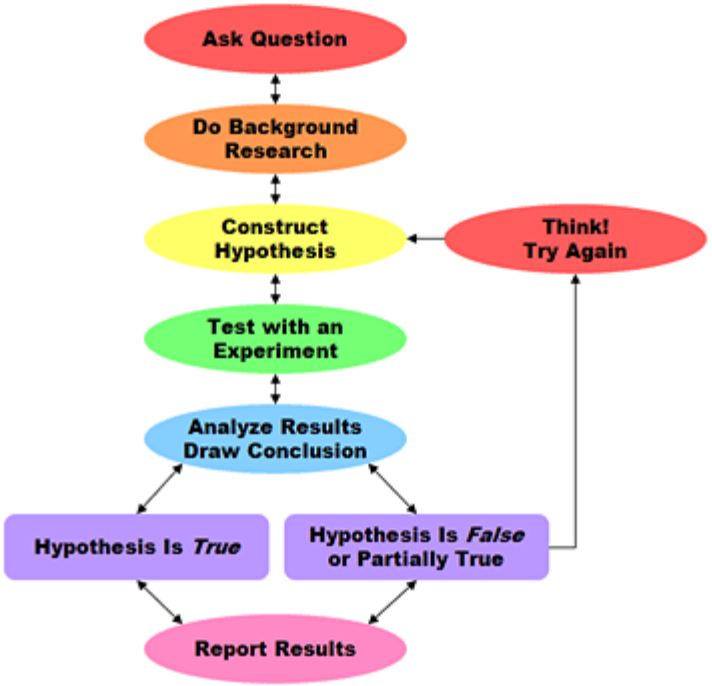

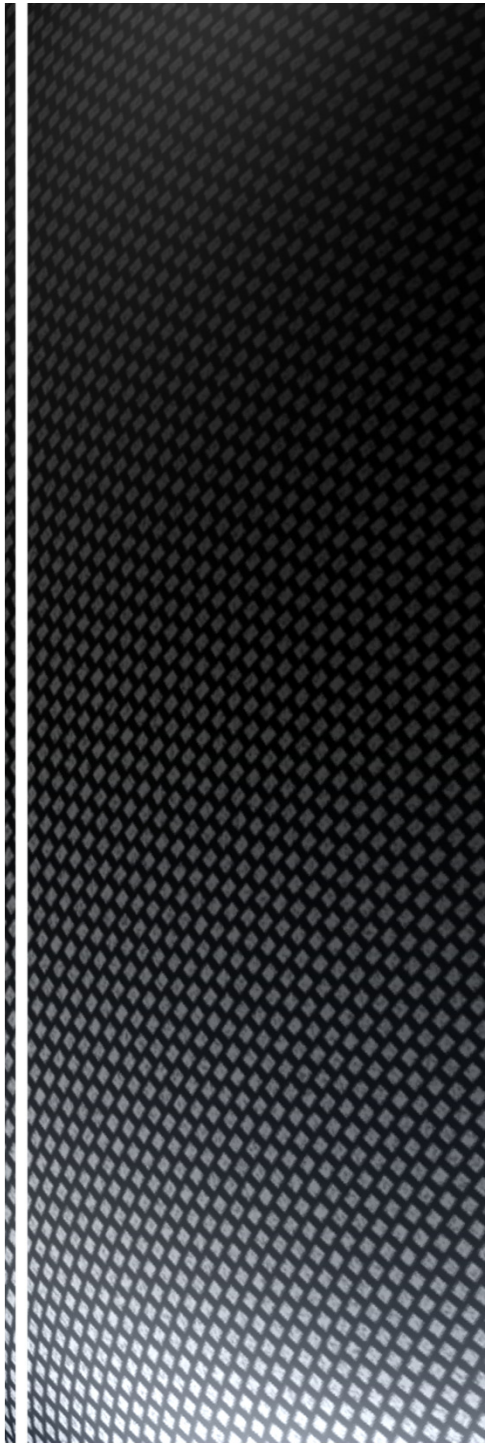

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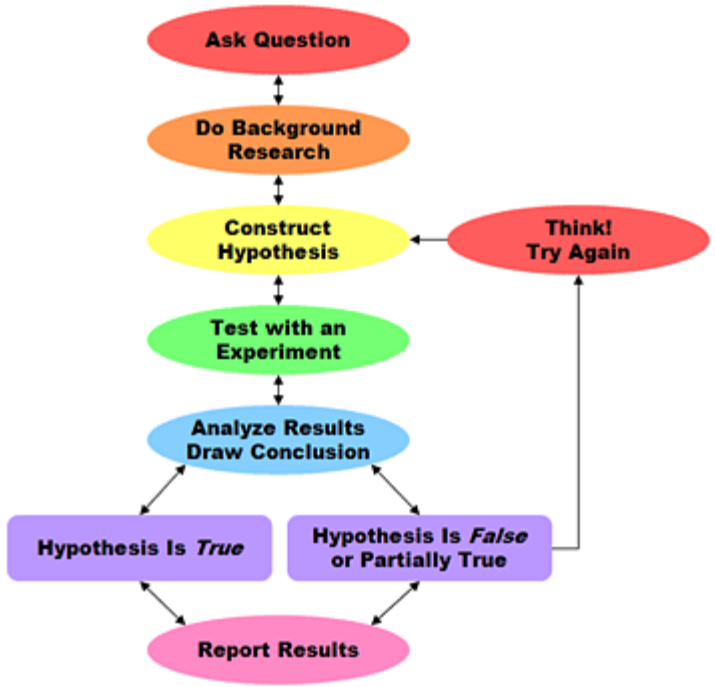

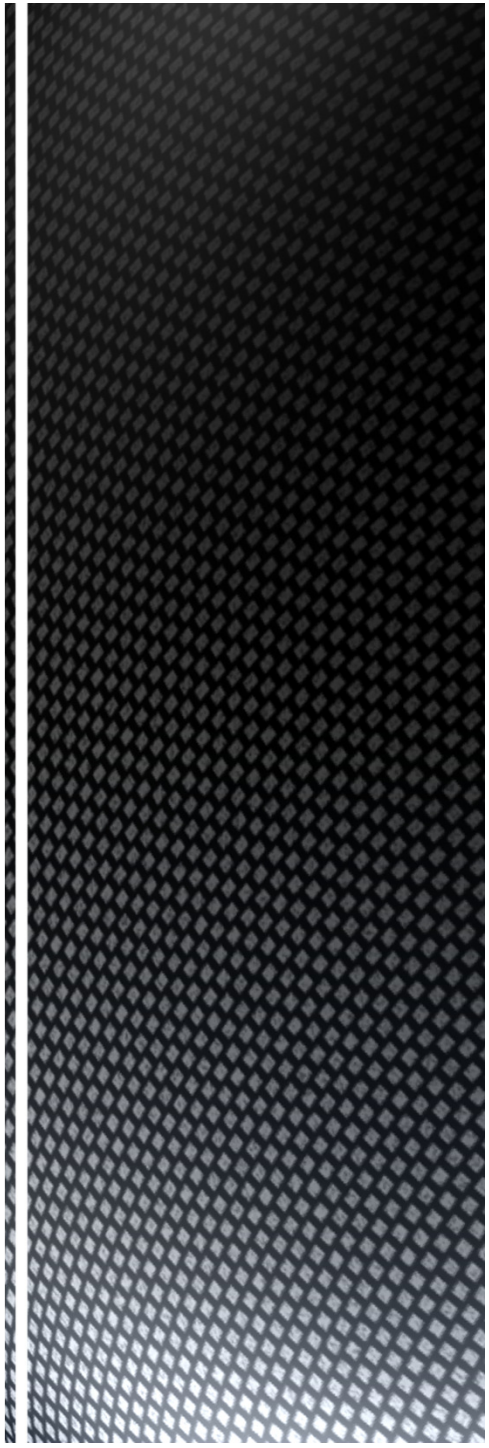

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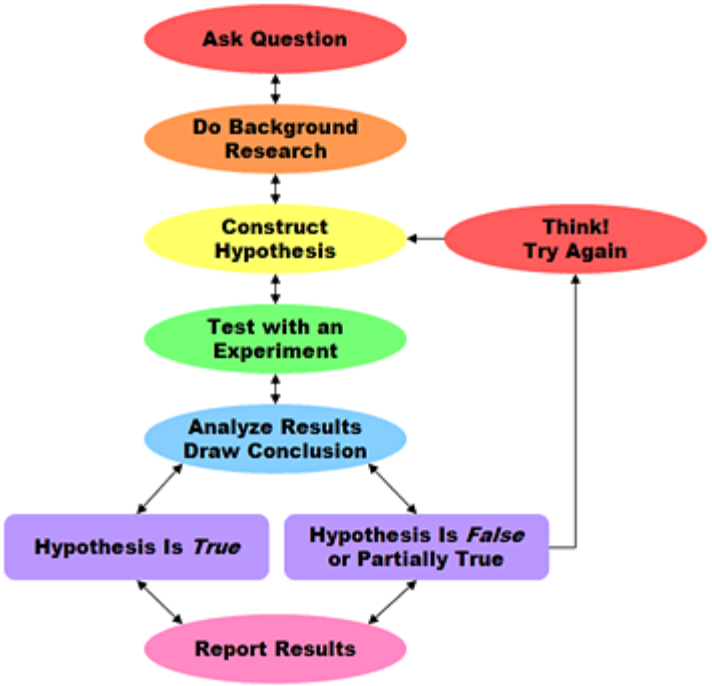

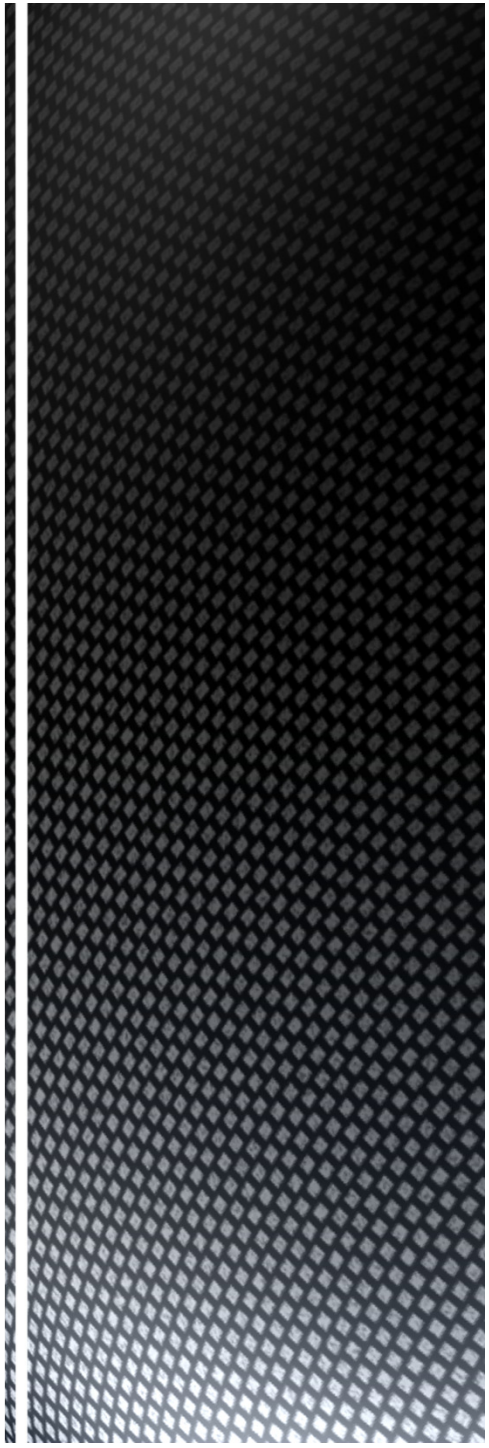

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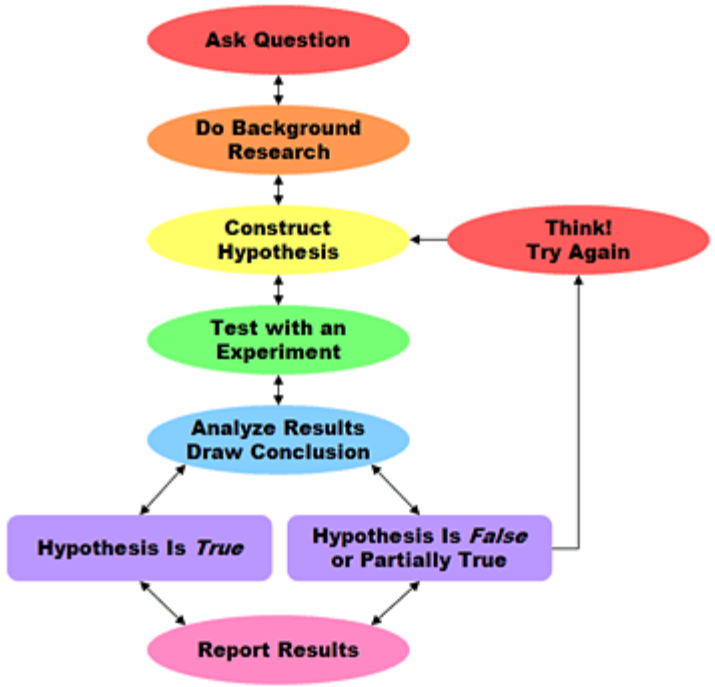

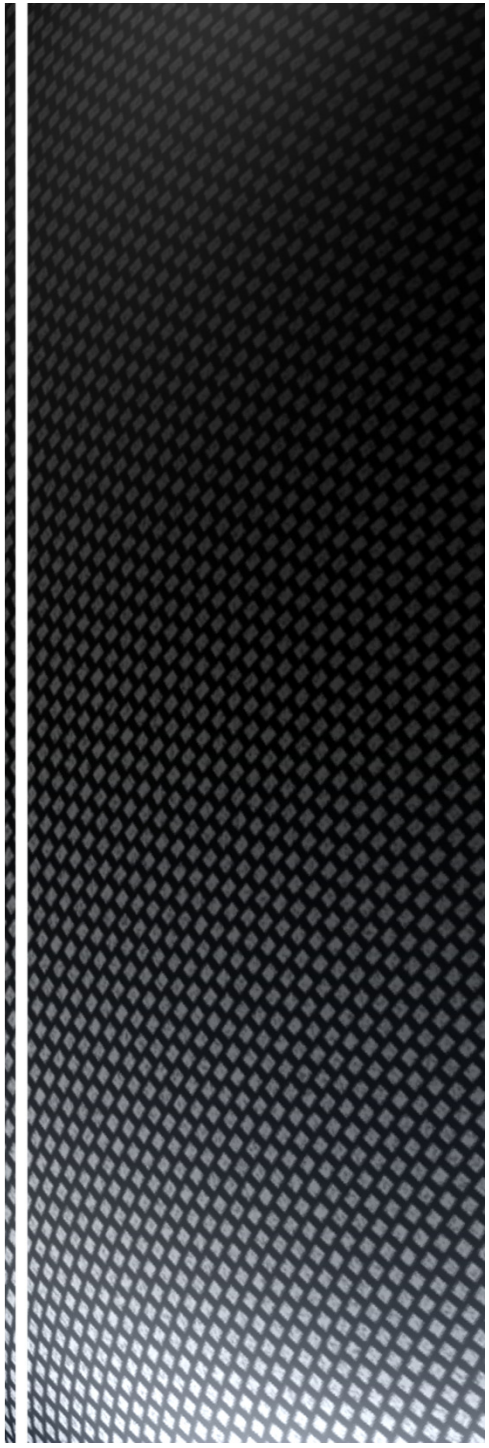

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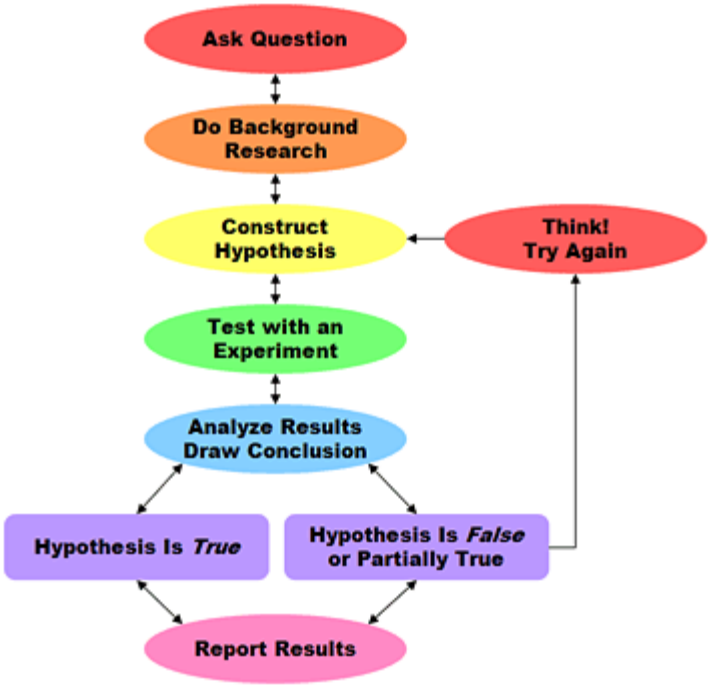

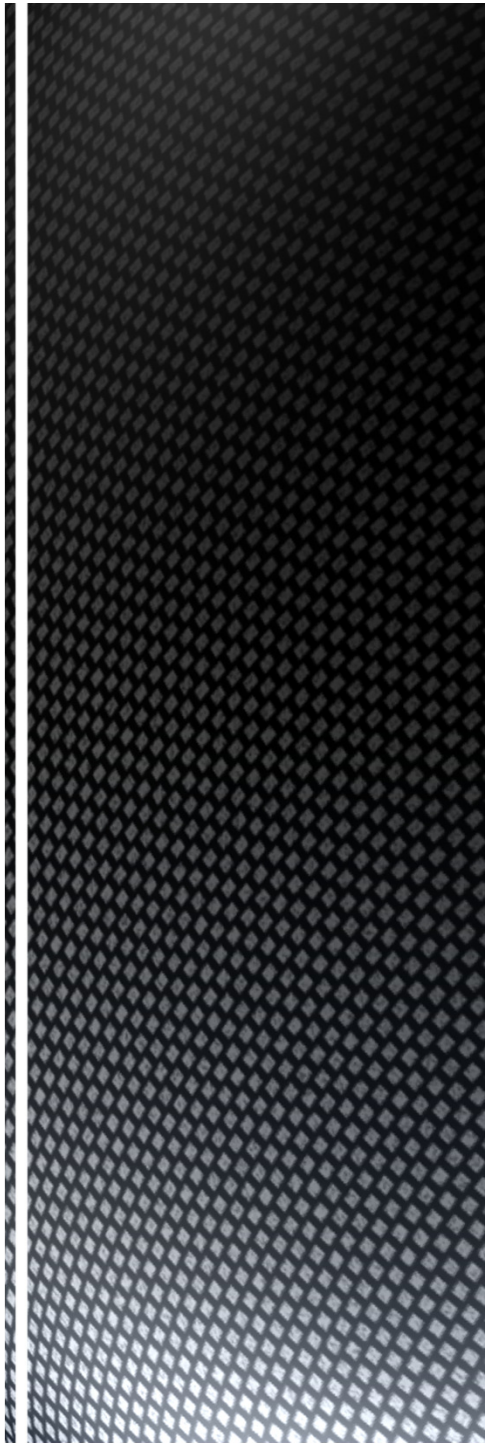

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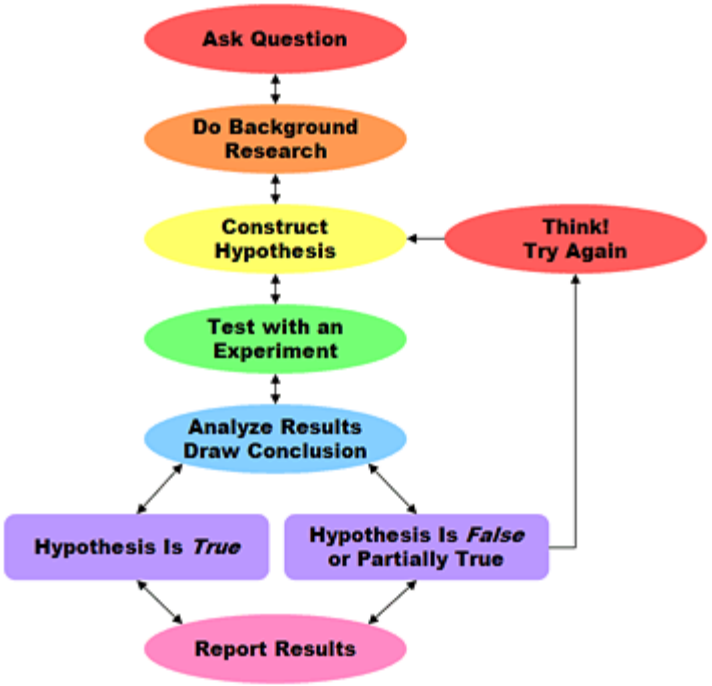
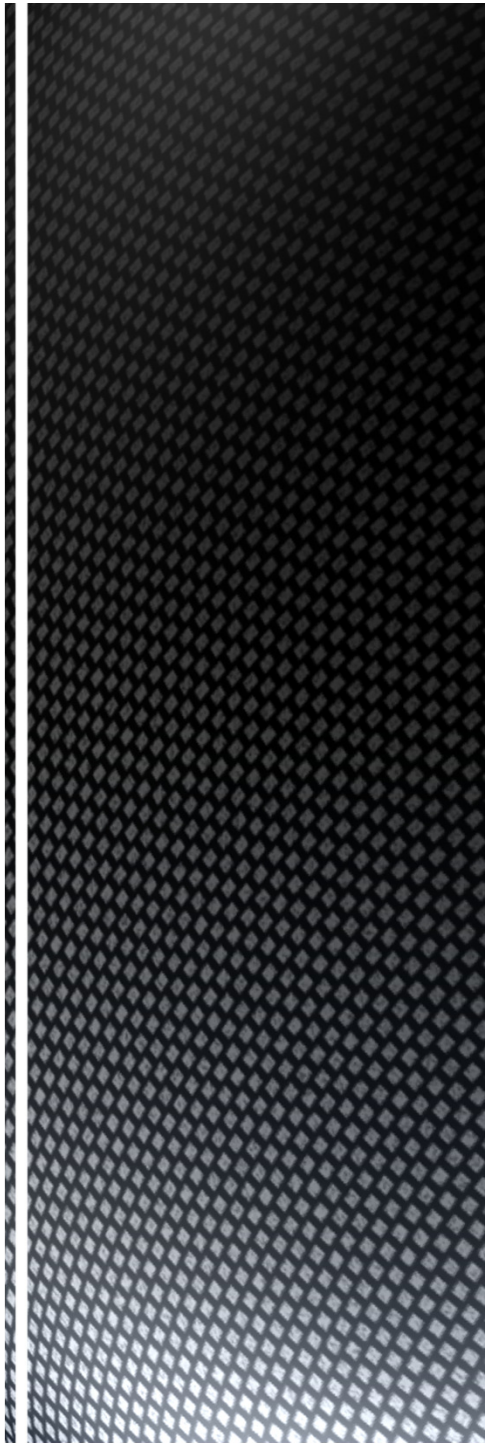
rinse and repeat.

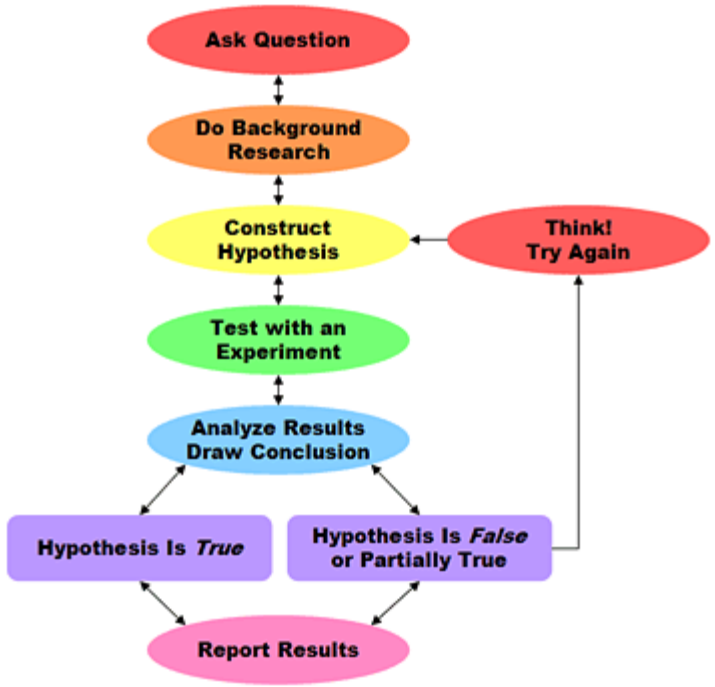


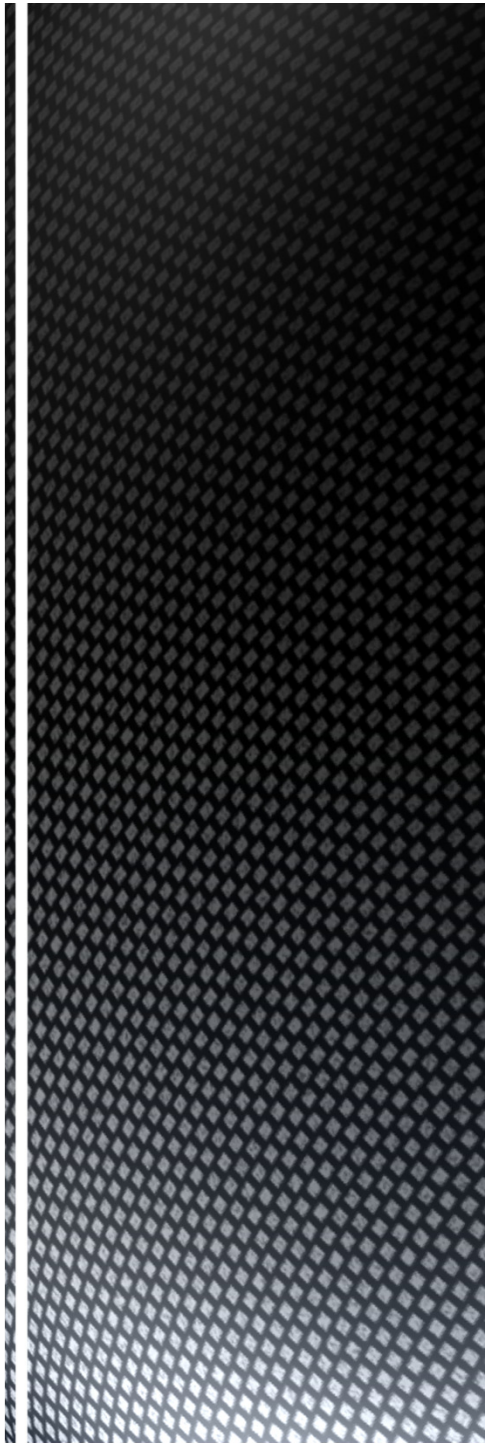


Troubleshooting

keep these in mind:

occam‘s razor





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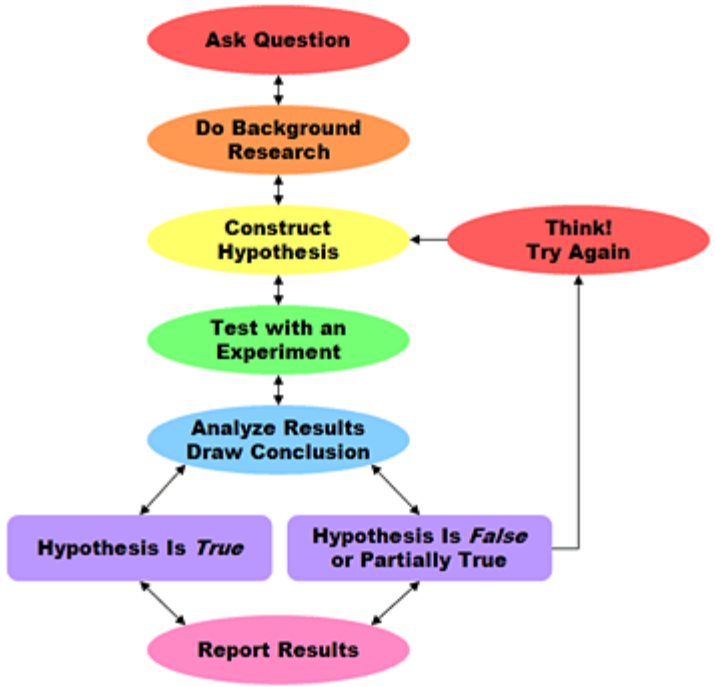

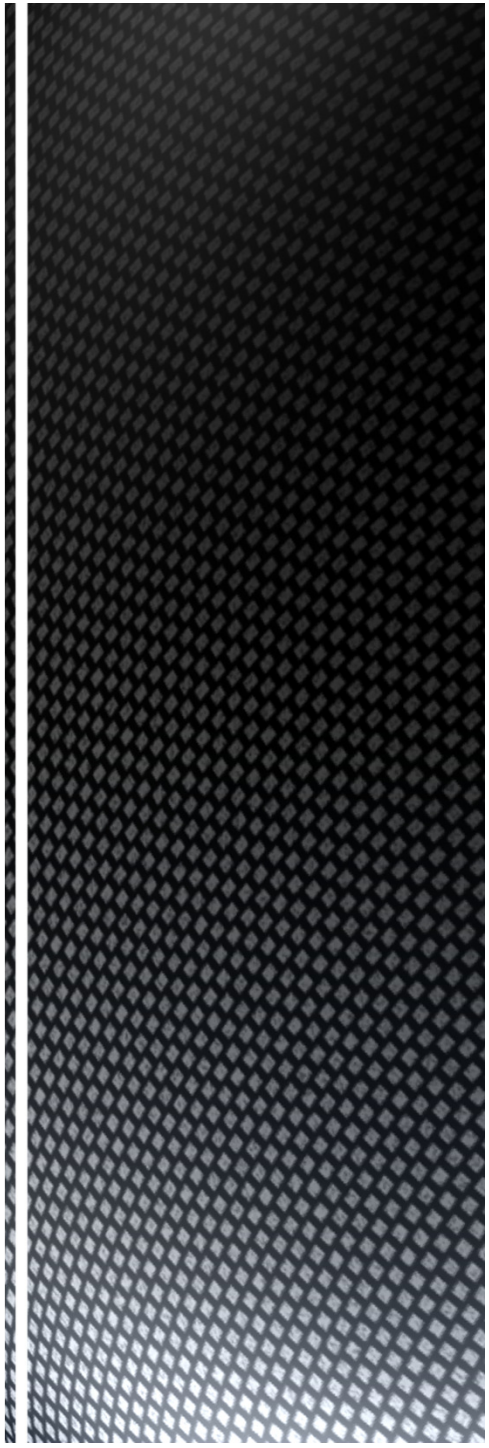

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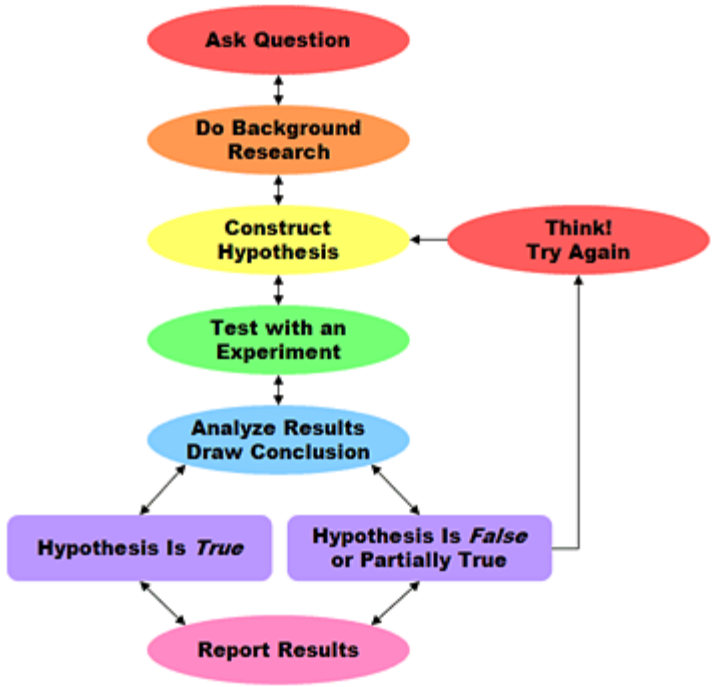

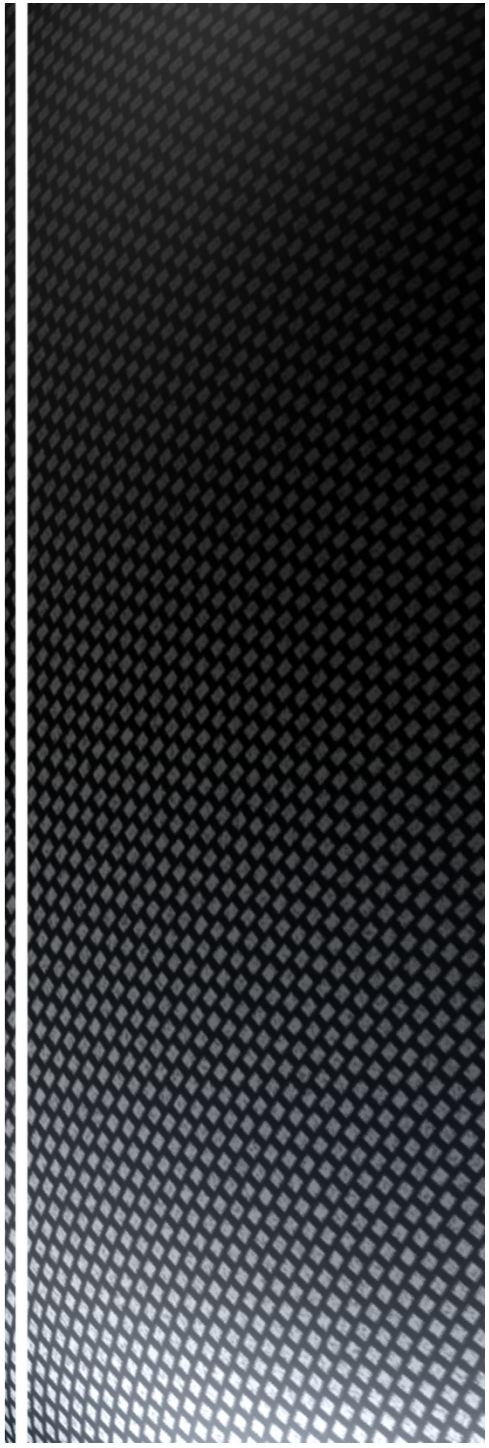

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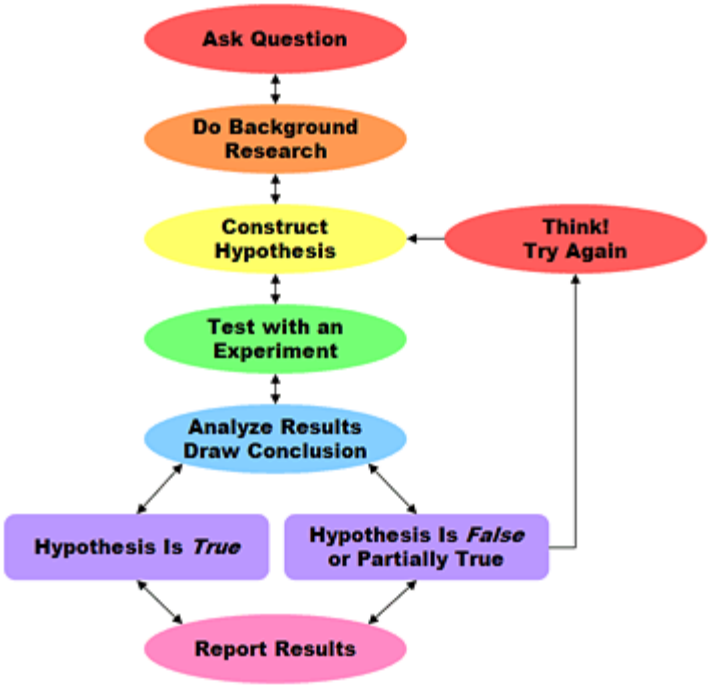

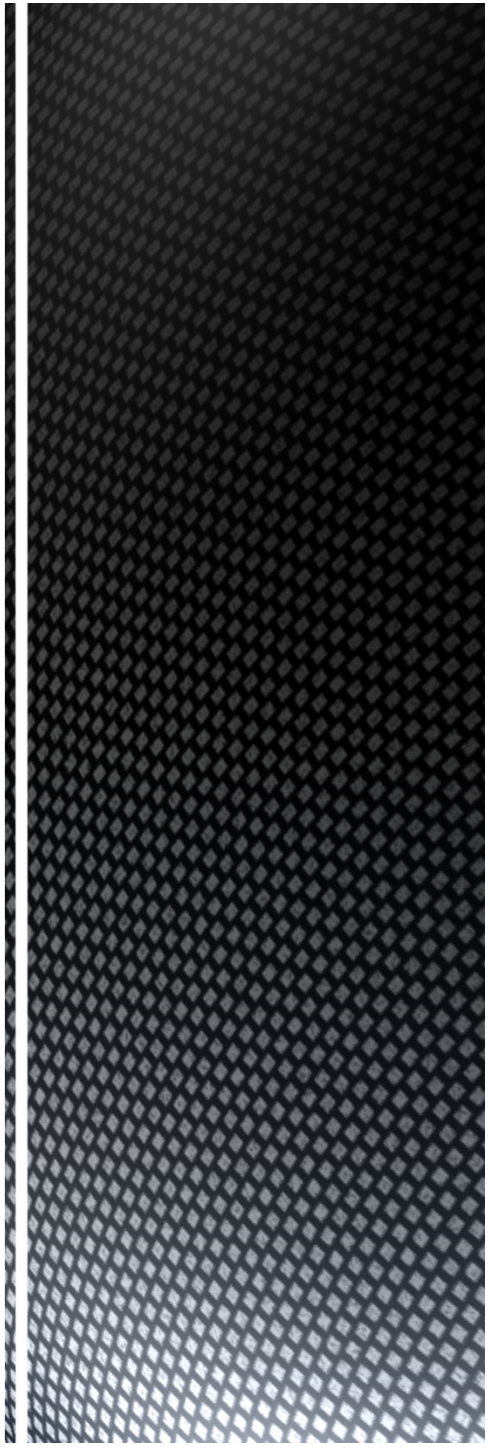

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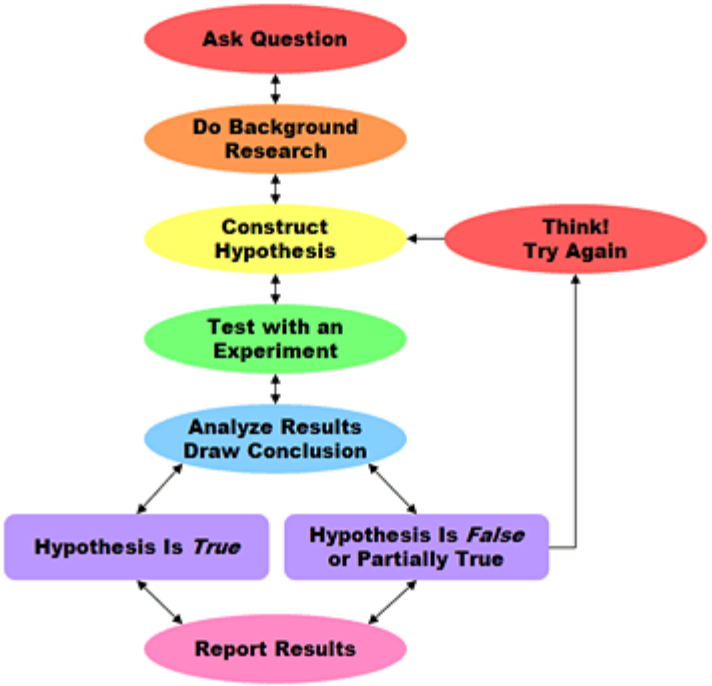
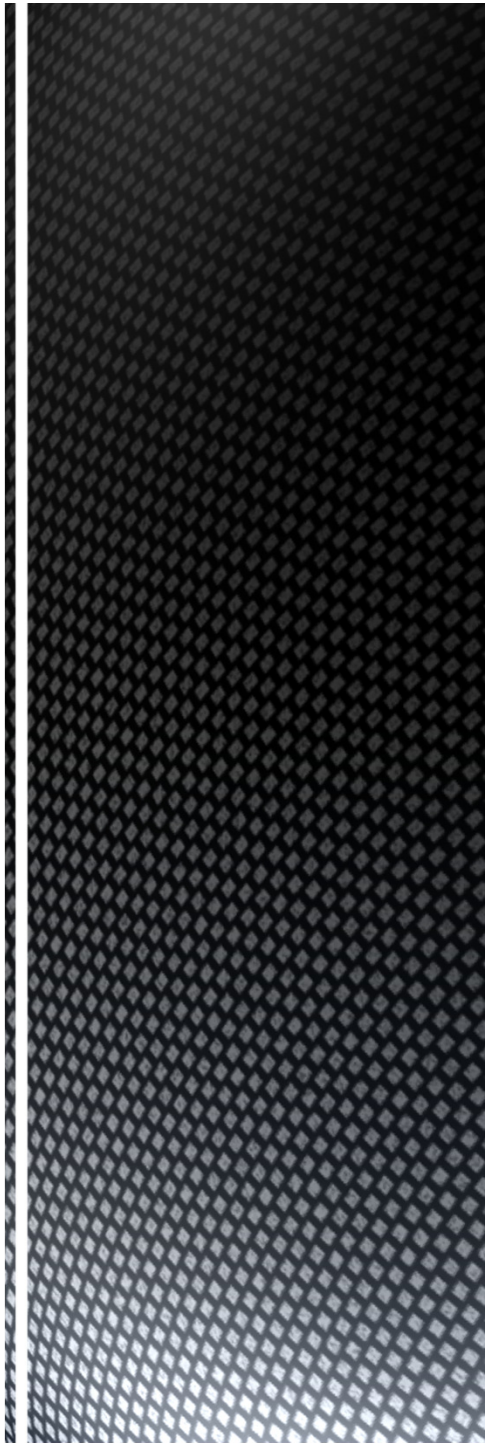
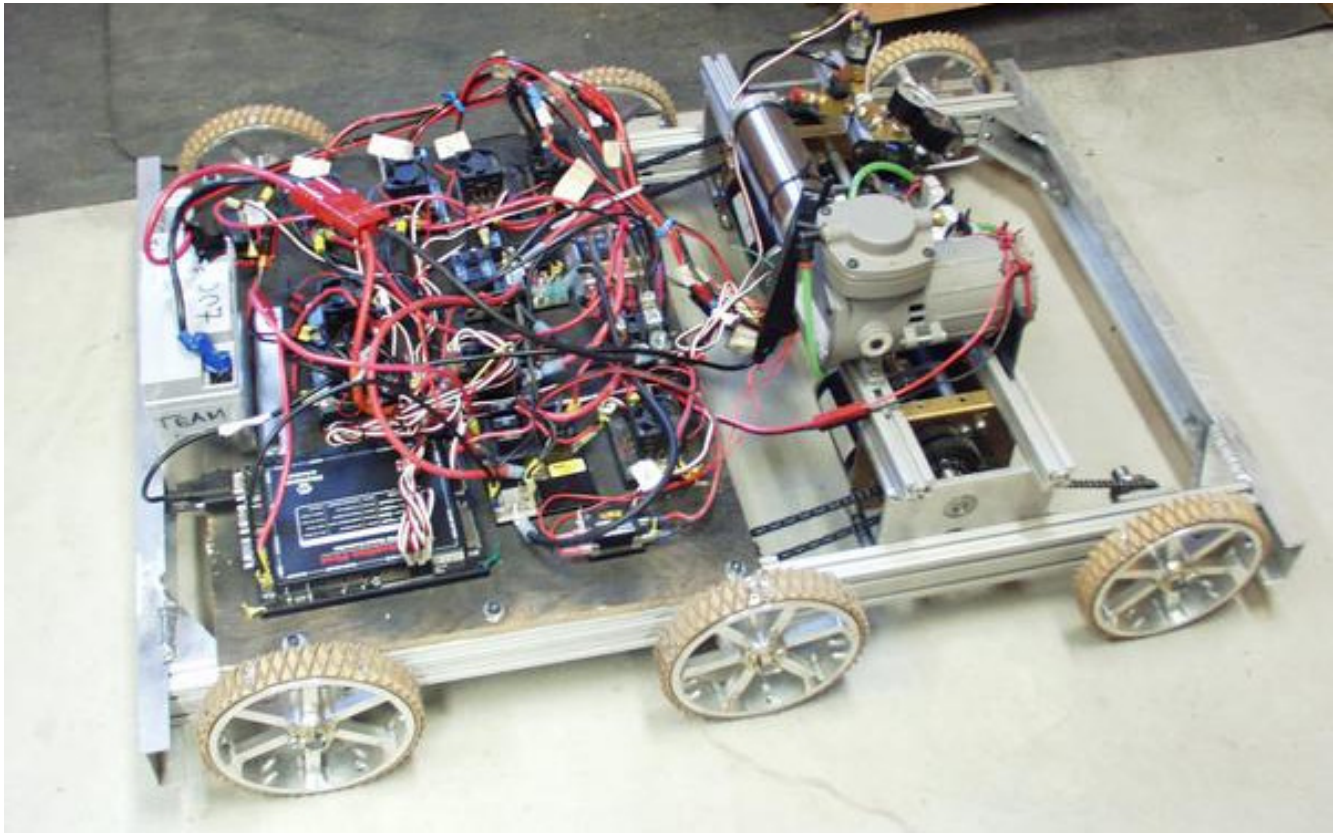
using Jaguars on CAN? know the errors. minimum one guy on electrical, one guy on programming who knows them inside out.





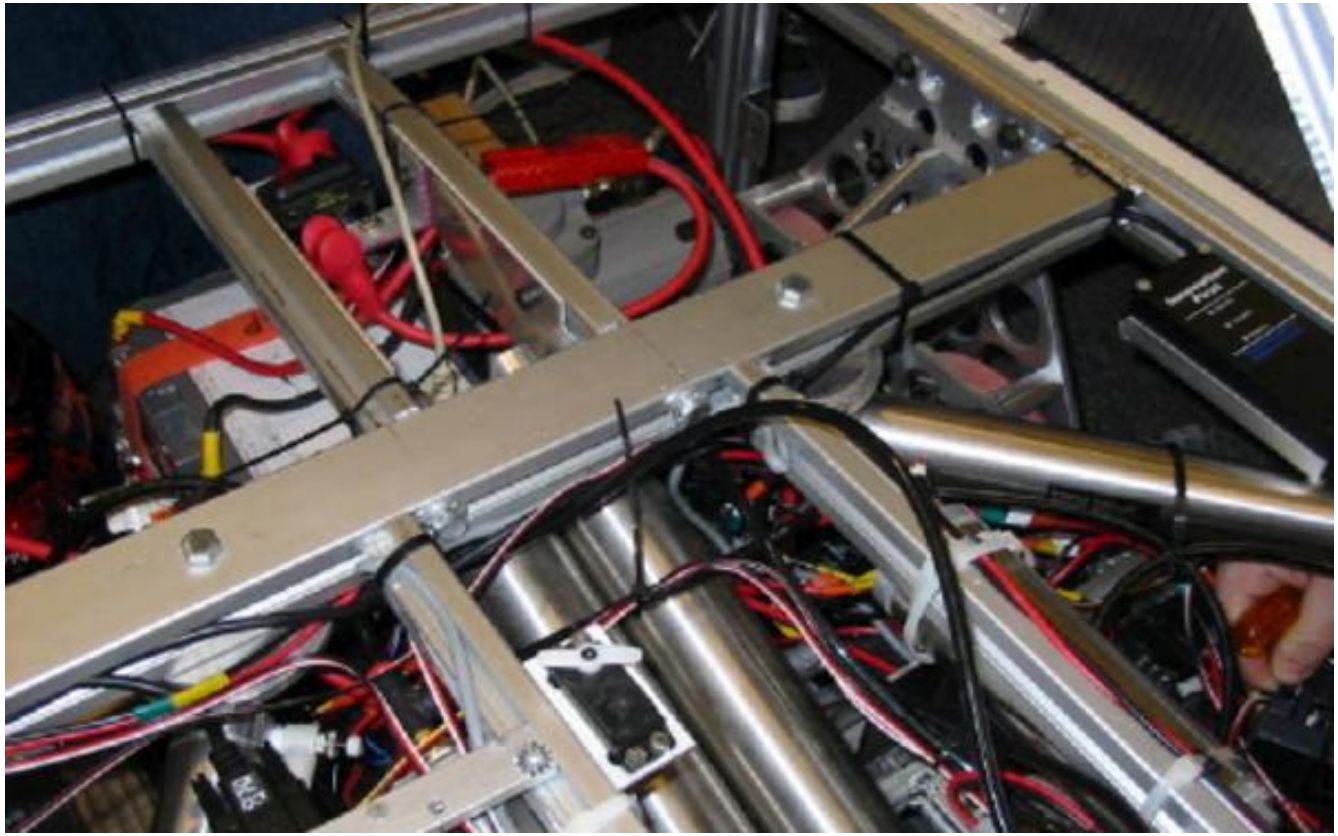
Wiring practices



Source: Martin Taylor, FRC100 Wildcats

what here is good? what here is bad?

Wiring practices



Source: pras870, FRC870 R.I.C.E.

what about here?

Wiring practices

do:

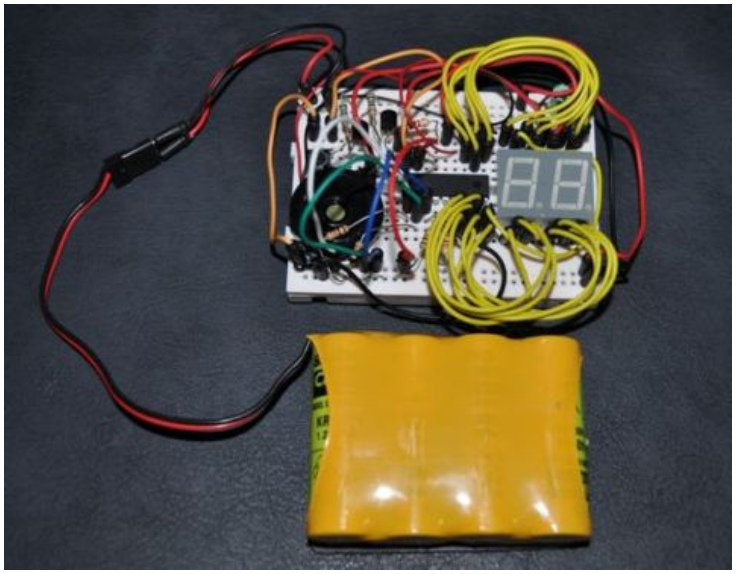
color-code & label!

red & black for power

white for signal

never use other colors

i use heat shrink to color-code/label long wire runs and sticker labels for CAN IDs, PWM ports, etc



quick! which wire do I cut?

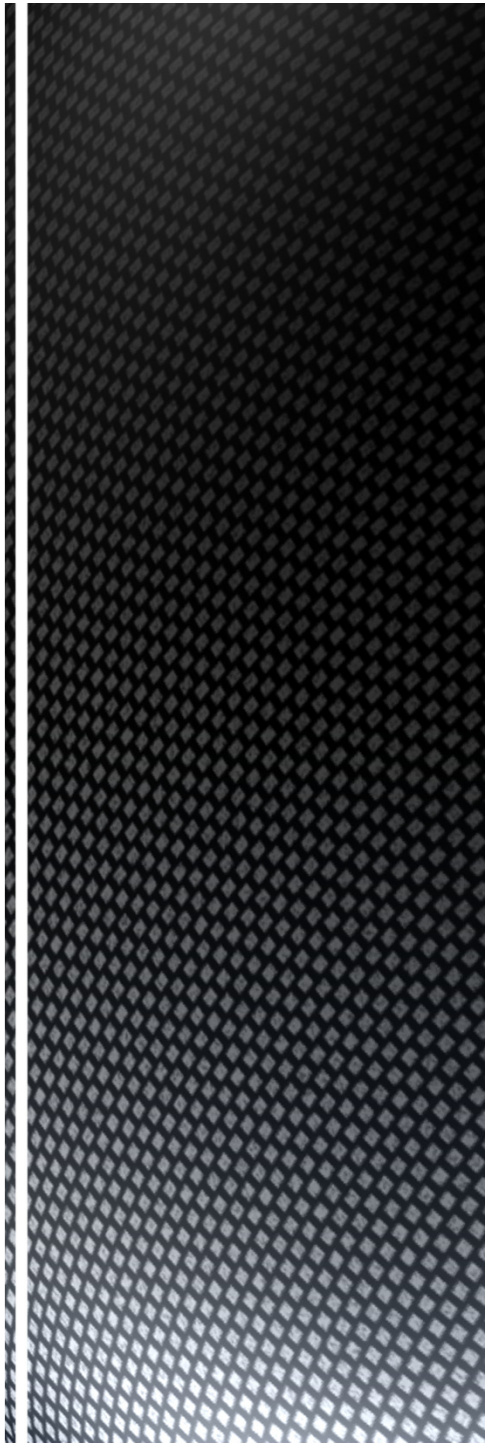
Wiring practices

do:

serviceability! – this requires accessibility and modularity.

you just came off the field and need to replace a fried Victor, but it's under two crossbars and a gearbox and it's screwed down, and you have to get in queue for your next match NOW and run a systems test to make sure everything is working.

[insert expletive here]



Wiring practices

do:

modularity, continued

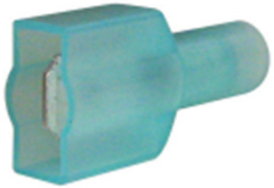
i like quick disconnects:

stud mounting tabs, Digikey A27859-ND

¼" insulated female 14-16AWG, All Electronics 6225

¼" insulated male 14-16AWG, All Electronics 4225

$^{3}/_{16}$" uninsulated female 14-16AWG, All Electronics 1250

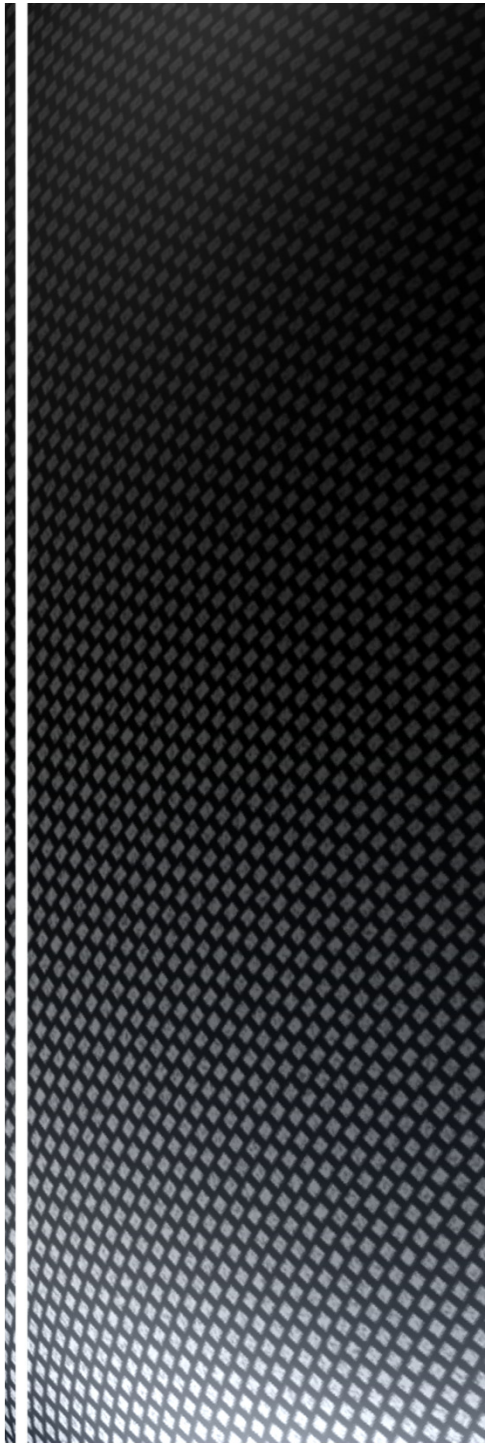


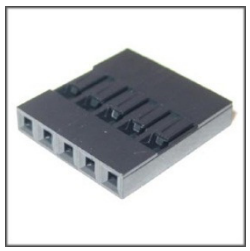
stud tabs makes swapping speed controllers easier; no need for screwdrivers after assembly

also consider powerpoles:

PP series on Powerwerx

am-2198 on Andymark





Wiring practices

do:

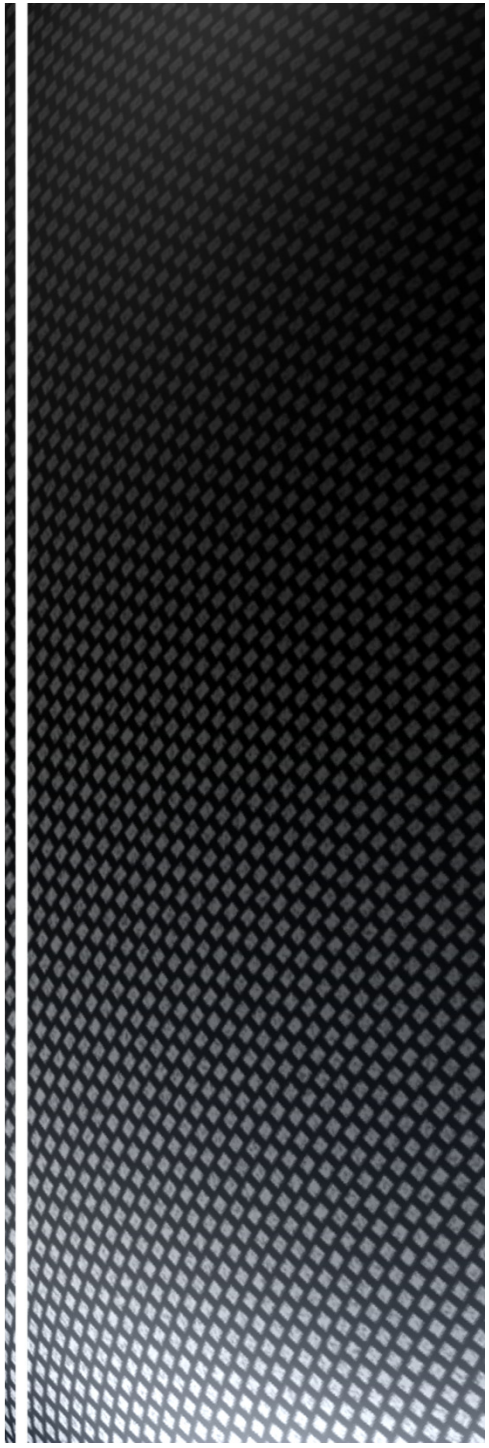
modularity, continued

get your own RC cable supplies and make them yourself; don't buy them – custom-made beats pre-made and makes your life a lot easier

i use Hansen Hobbies (alt. Jamesco)

get female pins, male pins, a LOT of servo wire (we use 22AWG economy), 1x2, 1x3, and 1x5 (for Jaguars)

PRACTICE PRACTICE PRACTICE



Tools & supplies

wire:

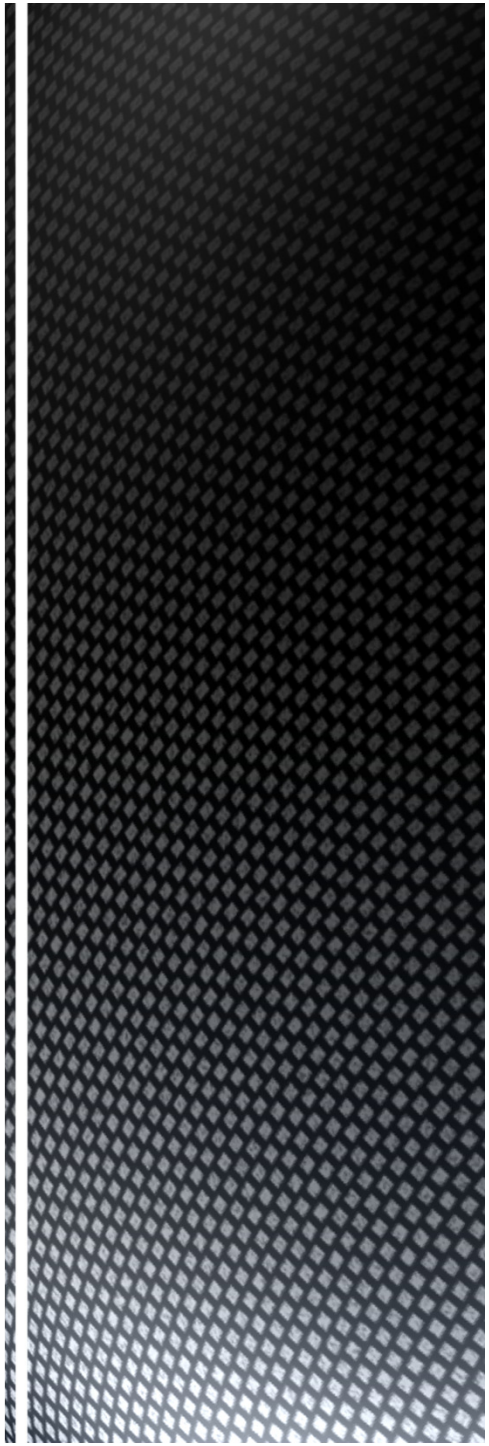
10 or 12 AWG, red and black – zip cord is very good, but errs on the pricey side

depending on usage, 16/18/20/22 AWG, red and black, for sensors and low-power applications

6AWG welding cable for battery cables (also buy red SB50s; they MUST be red)

for a custom OI:

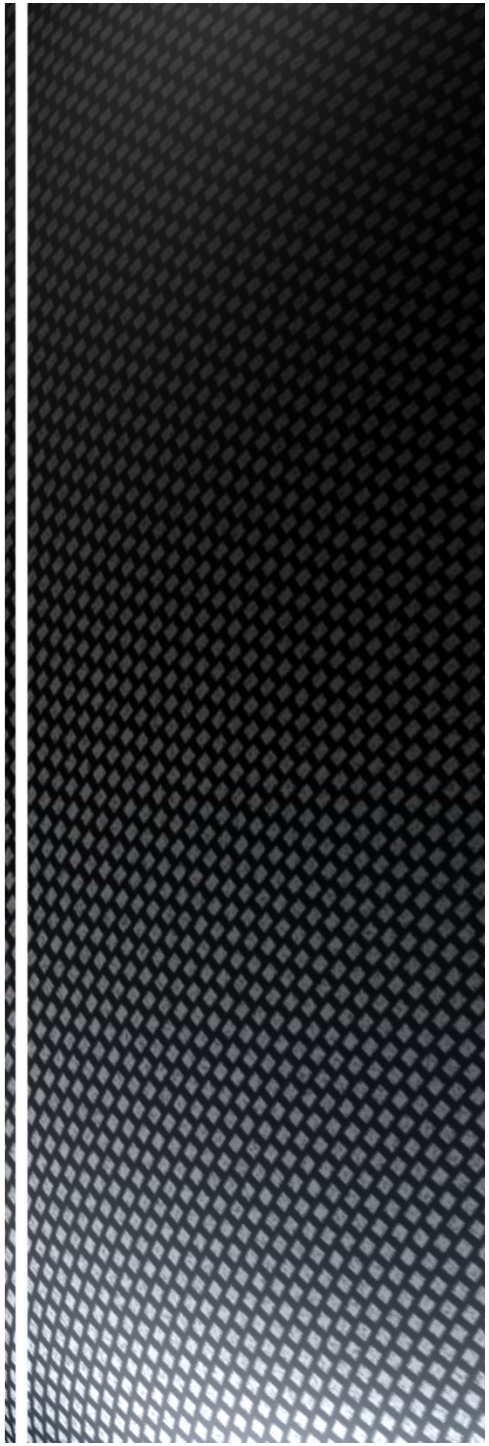
26/28/30 AWG, red/black + assorted, uninsulated 22AWG, female and male header pins



Tools & supplies

crimper and strippers: get good ones.

how many of you use this?



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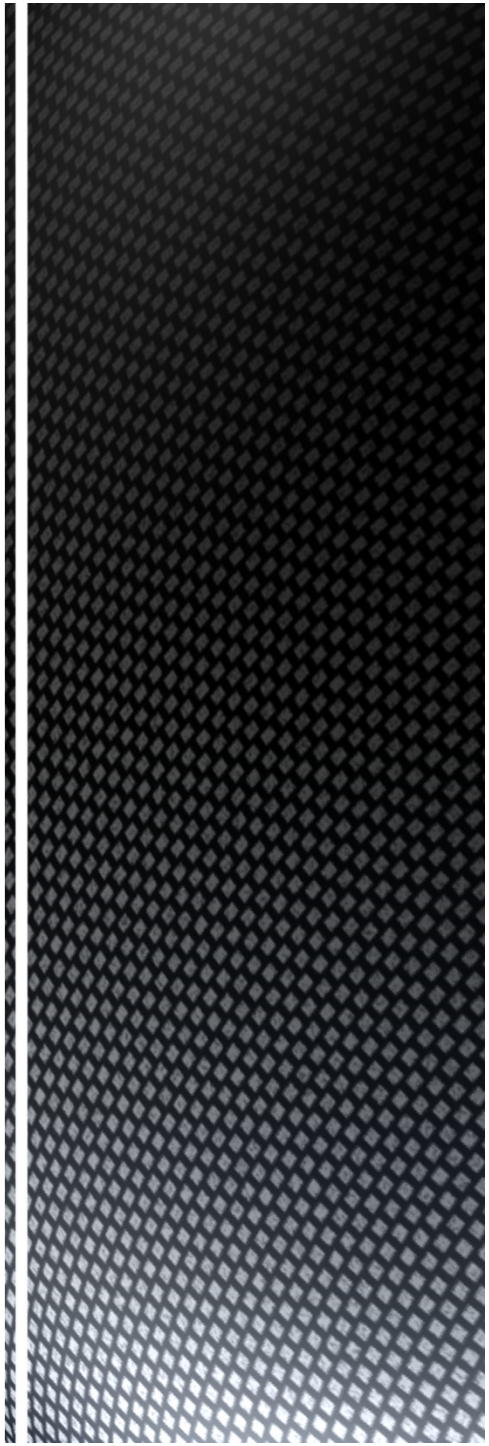
how many of you use this?

you all suck.



Tools & supplies

crimper and strippers: get good ones.

Powerwerx CT-75 is to die for ($17)

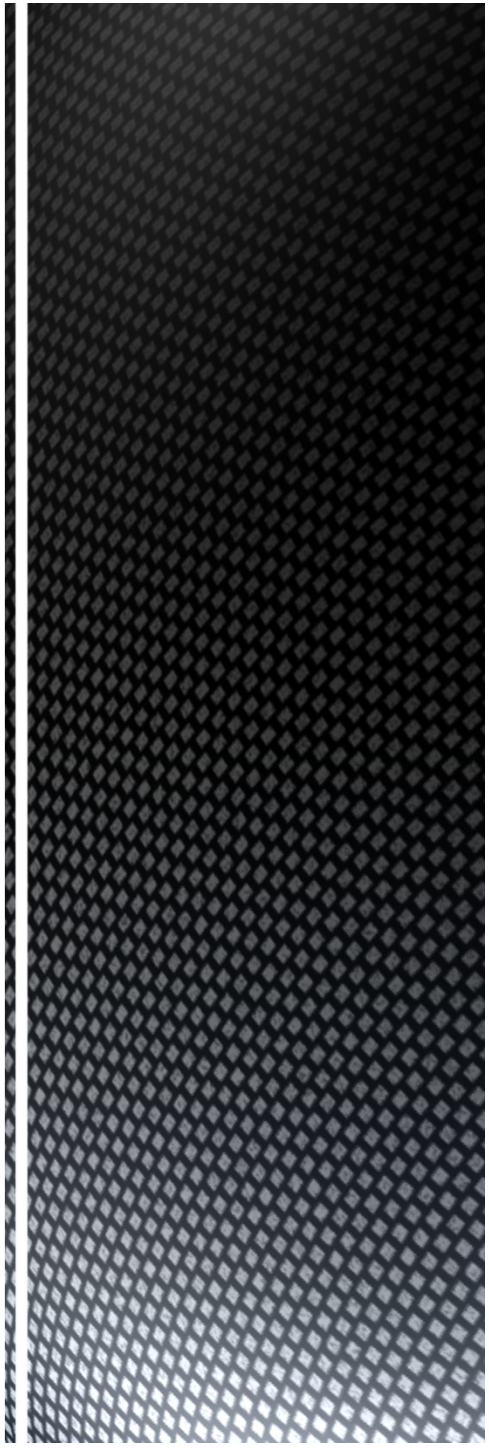
← something like this is also decent

there are multiple varieties of good strippers; just don't get automatic ones.

i recommend something like Xcelite 105SCGV (below left) or those that Hansen Hobbies carries, with something like (center left)

if you buy something spring-loaded, make sure it has a lock.

stuff like Xcelite 100X looks ridiculous but *is* good



Tools & supplies

flush cutter: better than diagonals.

small screwdriver, WAGO-sized, for all the terminals

compact multimeter with good probes, VDC, and audible continuity

RMS/averaging capability also recommended

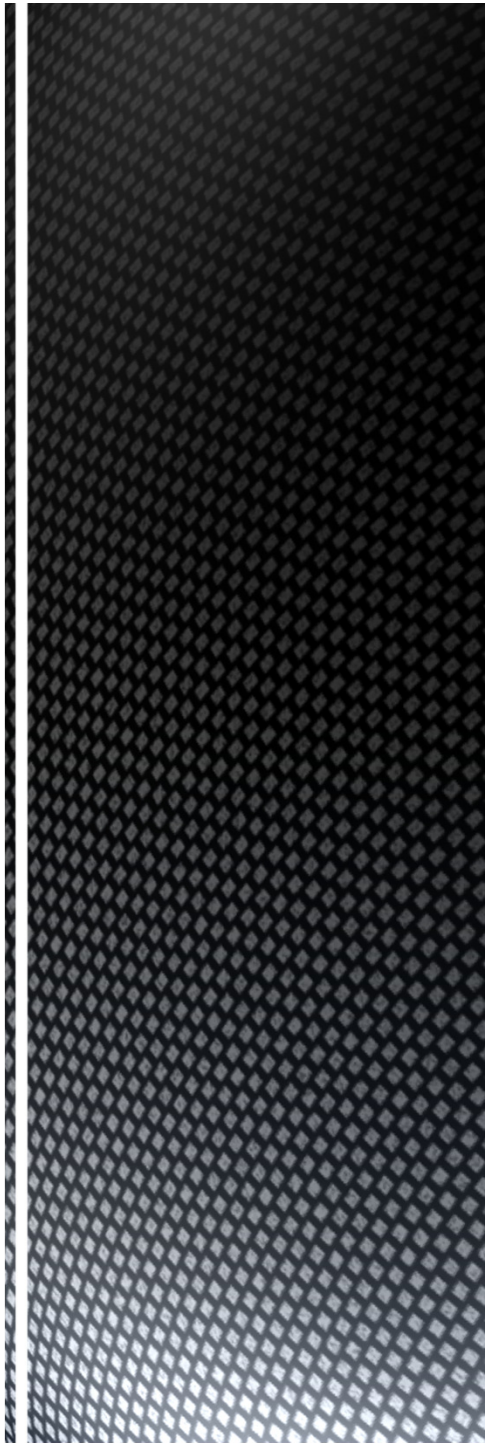
we have Digikey BK2700-ND (pictured), but it's out of stock

Amprobe PM55A (Digikey 705-1030-ND) supposedly good

fine point tip soldering iron w/ stand

not chisel tip; preferably max 60+W

also get thin and thick solder (18AWG, 28AWG)



Tools & supplies

ammeter (clamp on) and oscilloscope – very utile, but not very critical

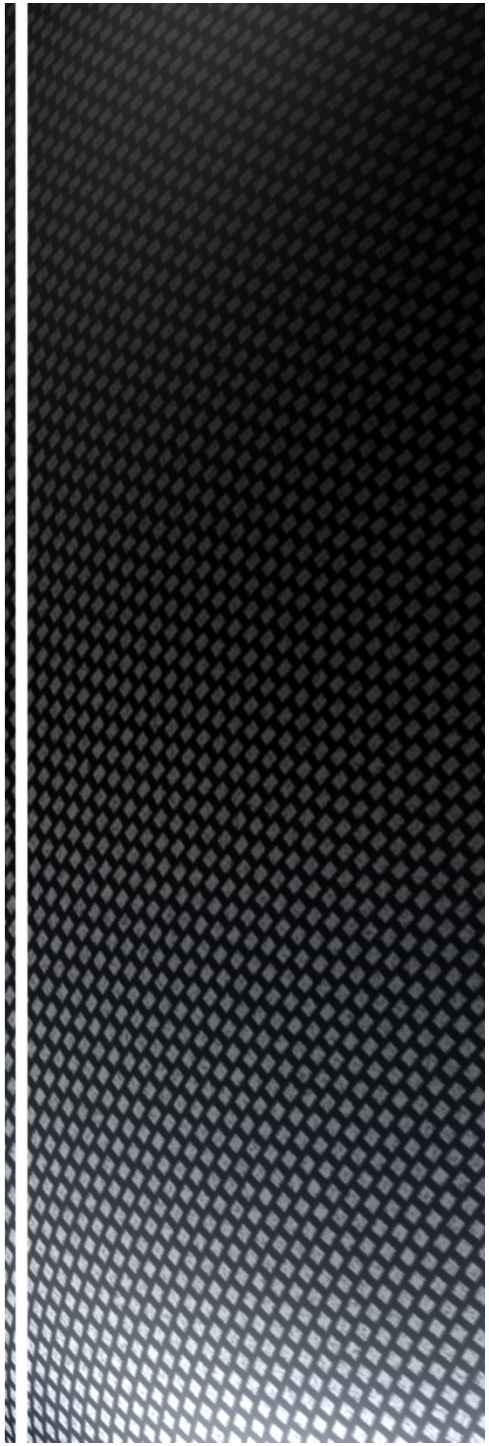
power inverter, like the units found in car chargers, but adapted for FRC (much like the one AM sells)

we took something like the one pictured to the left, hacked the car end off, soldered on leads going to a SB50, and filled it in with hot glue

small & medium (4” to 8”) zip ties

#4-40 and #6-32 hardware

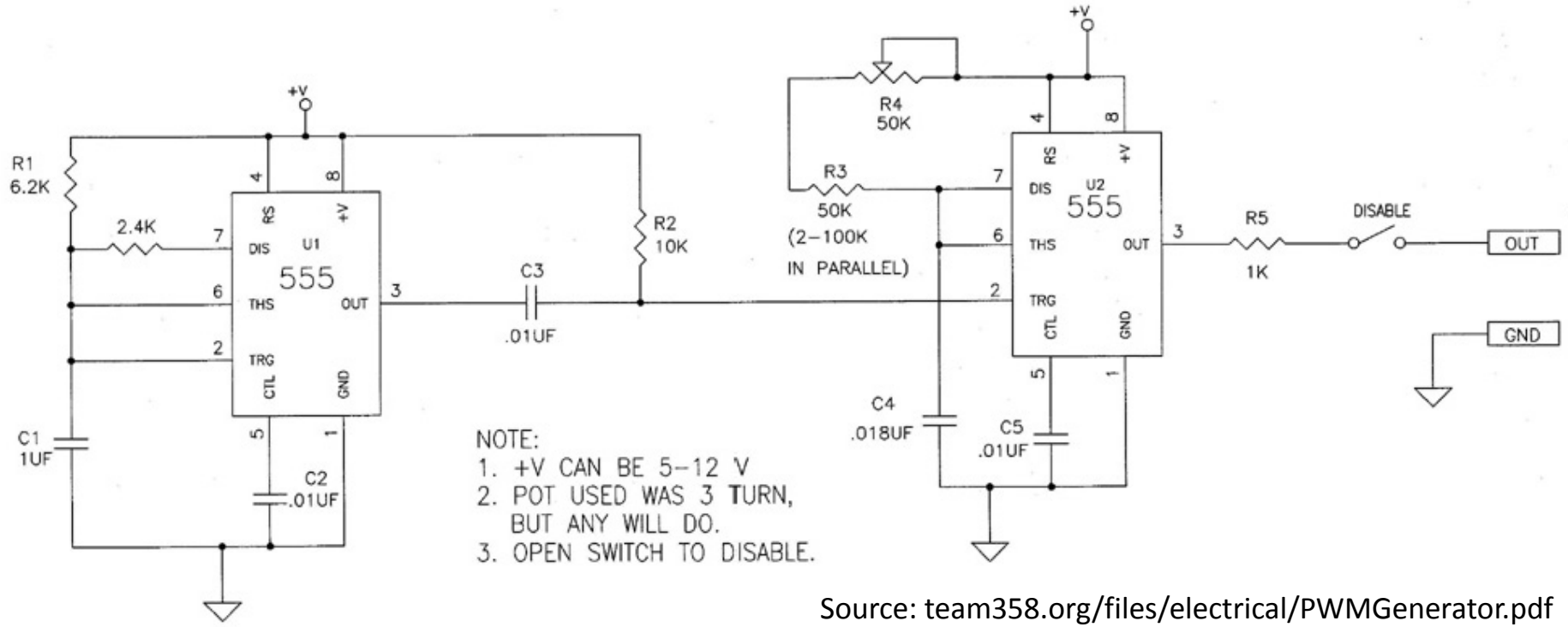
battery load tester
e.g. am-0095 Battery Beak



Tools & supplies

PWM signal generator

very useful for troubleshooting – allows you to test whether the problem lies at or downstream from the speed controller, or whether it's upstream from the speed controller



Source: team358.org/files/electrical/PWMGenerator.pdf

New in 2013

"**FRC Blogged - FIRST Choice, 2013 Control System, and Regional Slots**

"Blog Date: Friday, November 16, 2012 - 11:16

"Second, all teams will receive in their Kickoff Kit, and be required to use, a new wireless bridge. The new bridge is still a D-Link DAP 1522, but only the hardware Rev B version will be permitted."

http://www.usfirst.org/roboticsprograms/frc/blog-11-16-12

Source: Andymark, am-0839

New in 2013

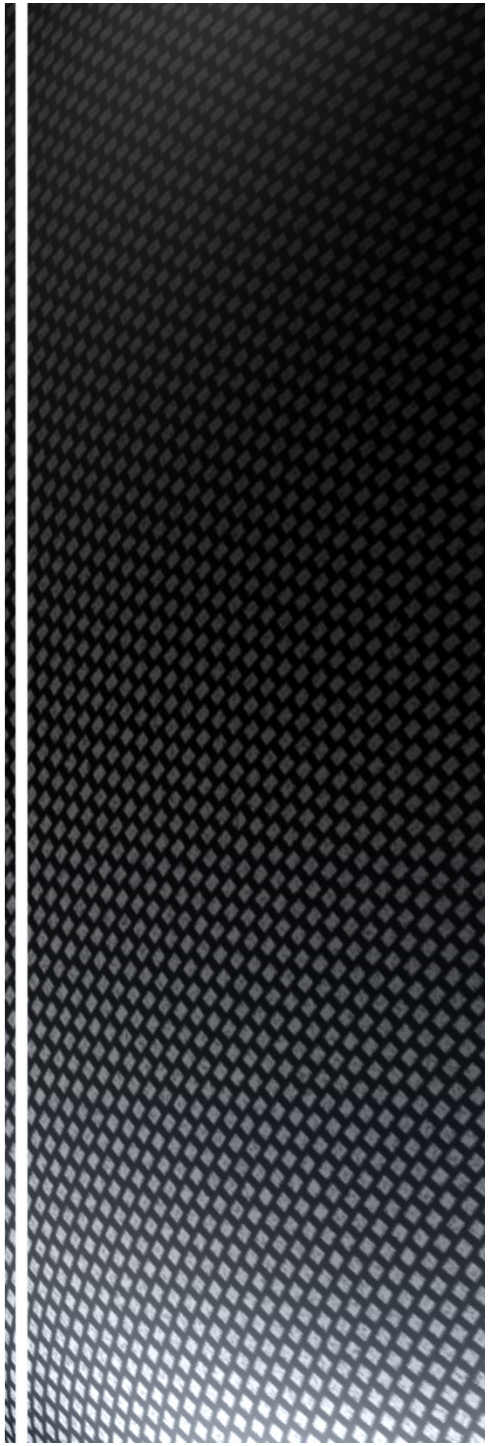
Talons, Andymark am-2195, $60

Victor 888s, VEXPro 217-2769, $50

Linearity

all speed controllers use a control signal to determine their power output

joysticks send a signal between -1 and 1
that signal is converted to a PWM duty cycle
speed controller converts PWM signal into a voltage between -12V and 12V



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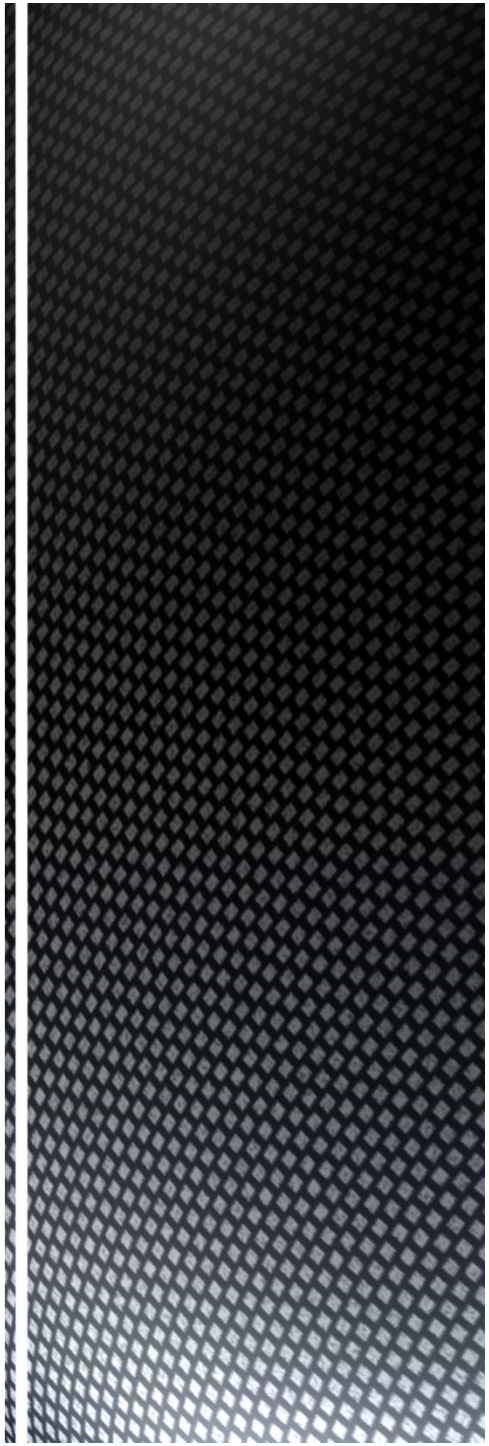

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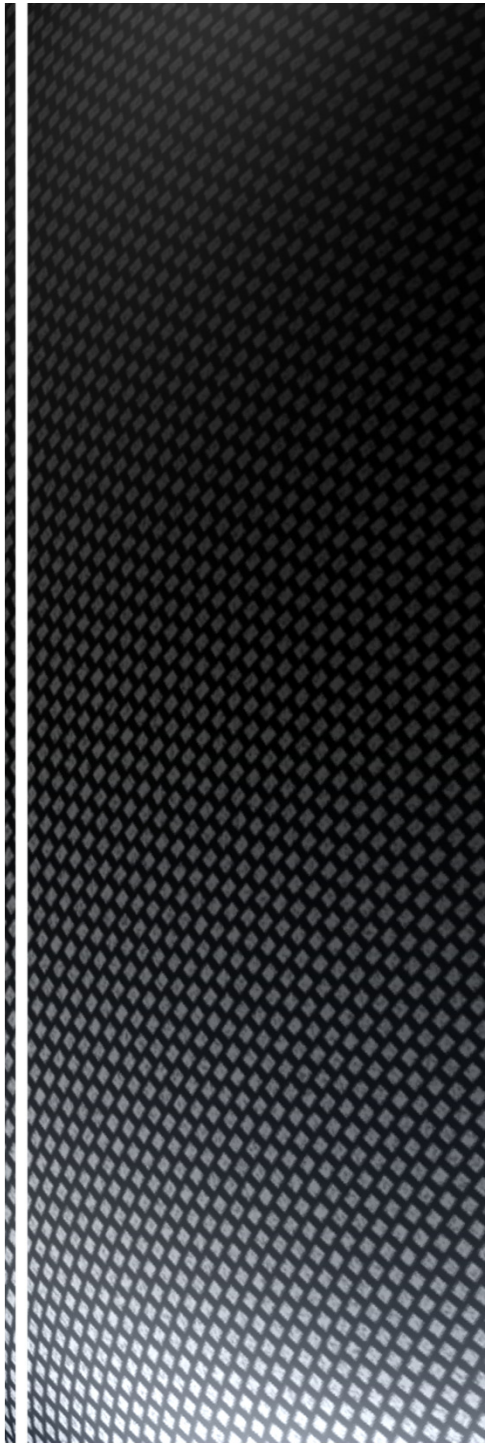
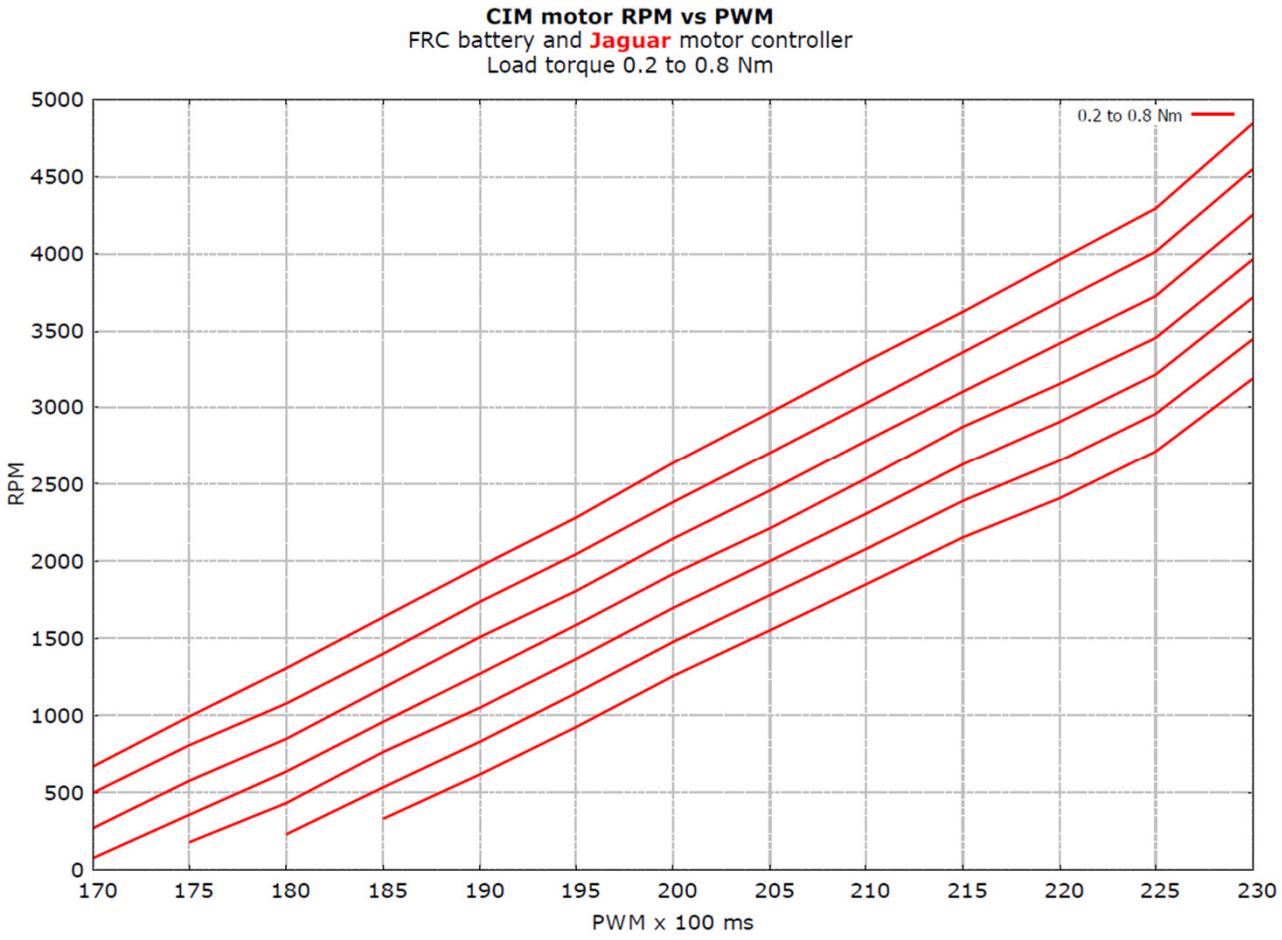
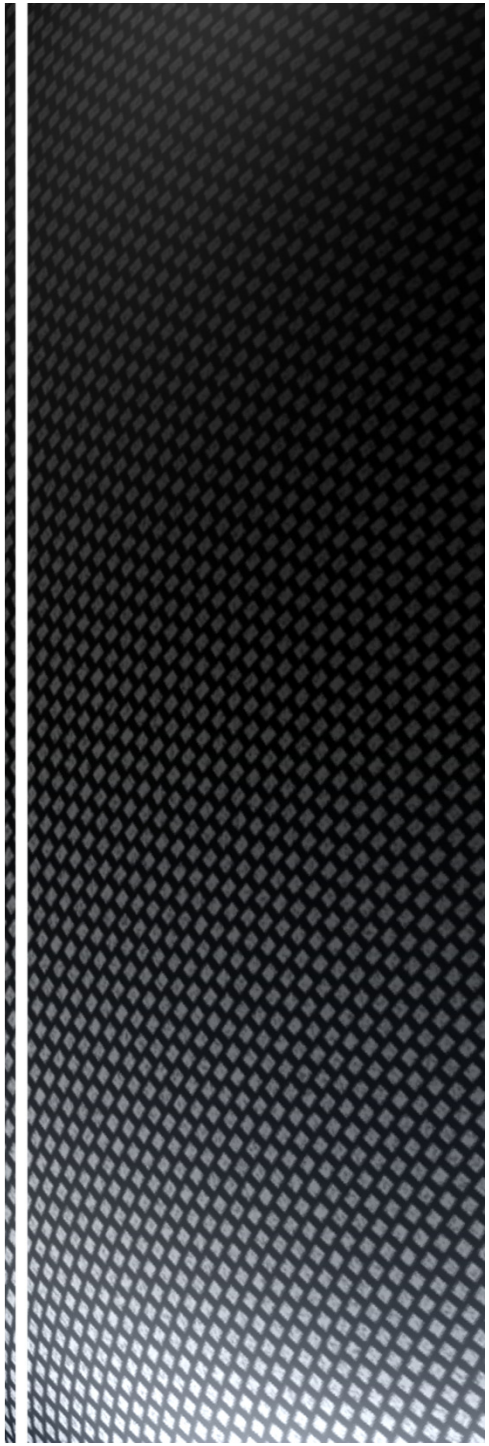


Linearity

that's true with the Jaguar:

Source: Ether, Chief Delphi

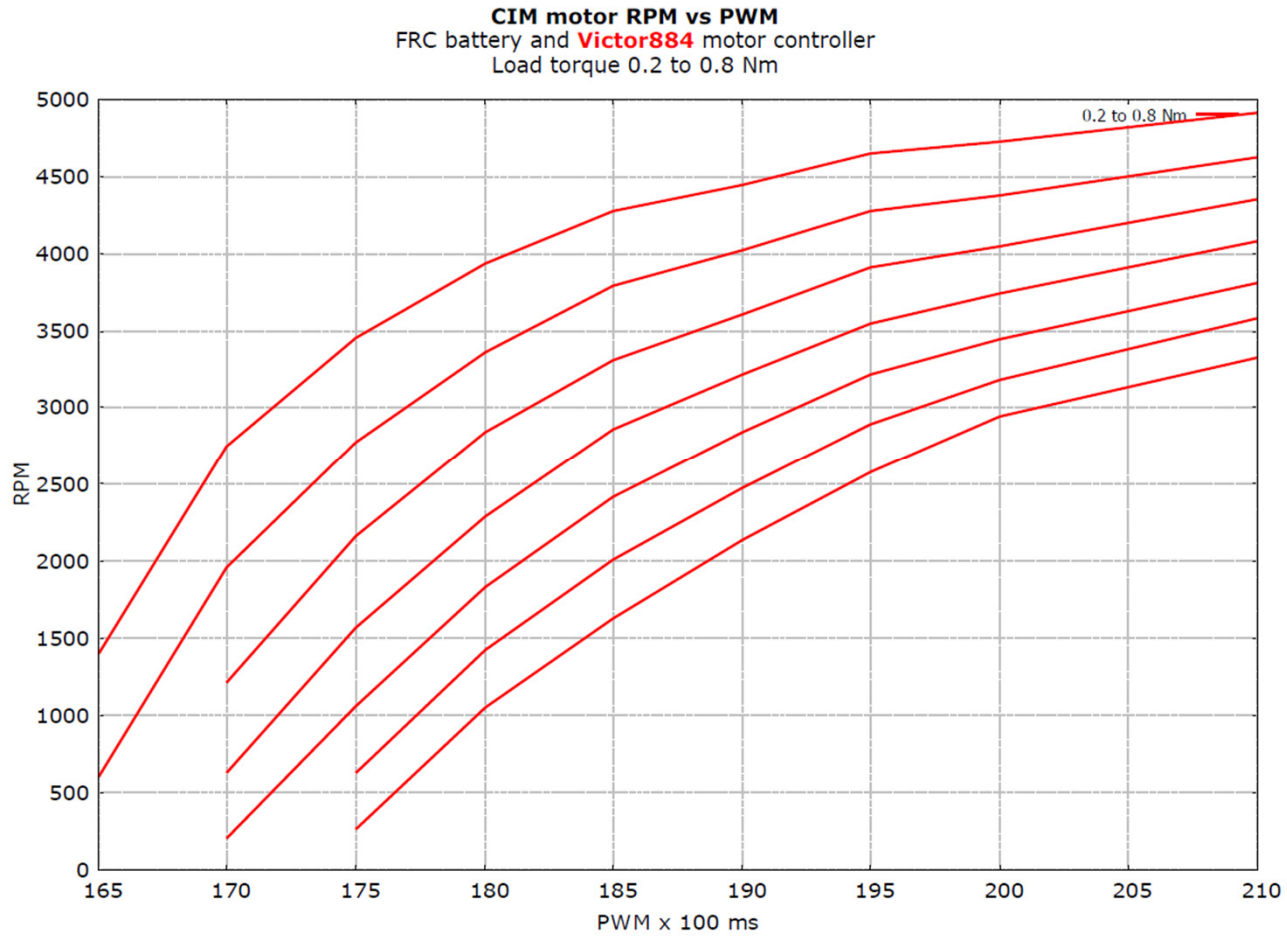


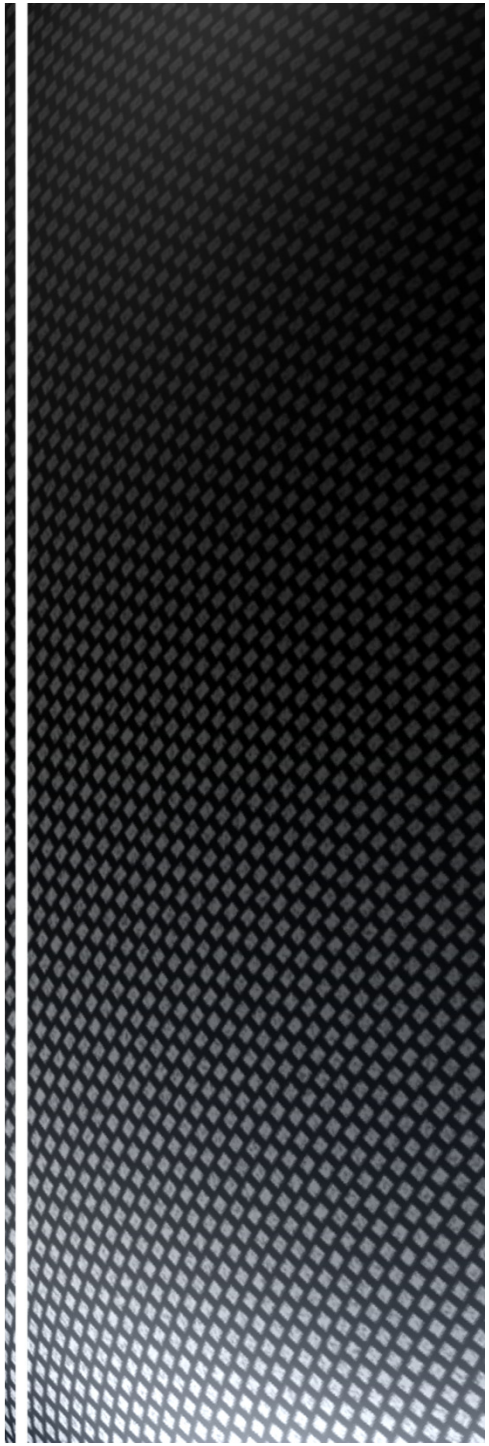


Linearity

but not with the 884:

Source: Ether, Chief Delphi

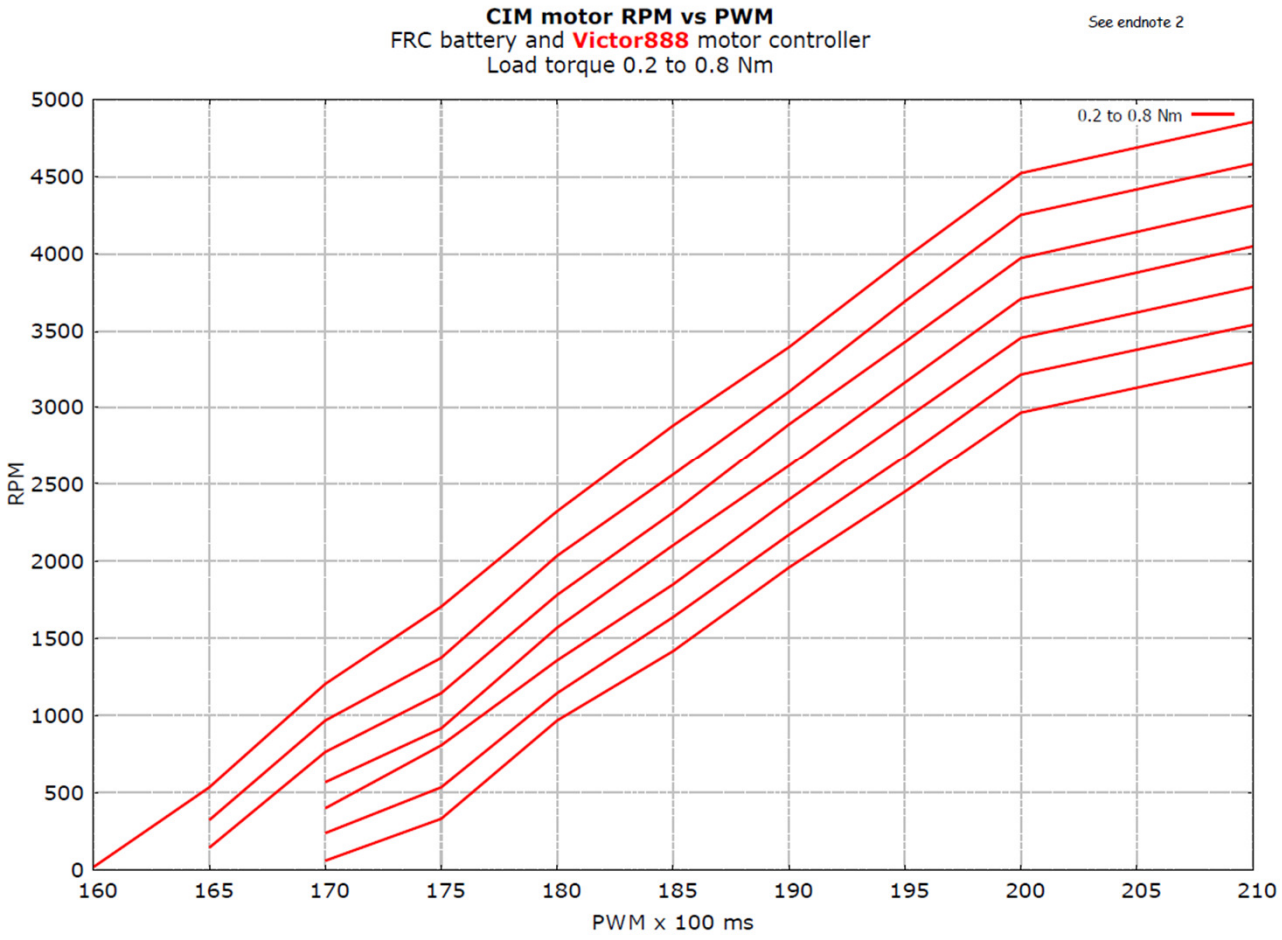


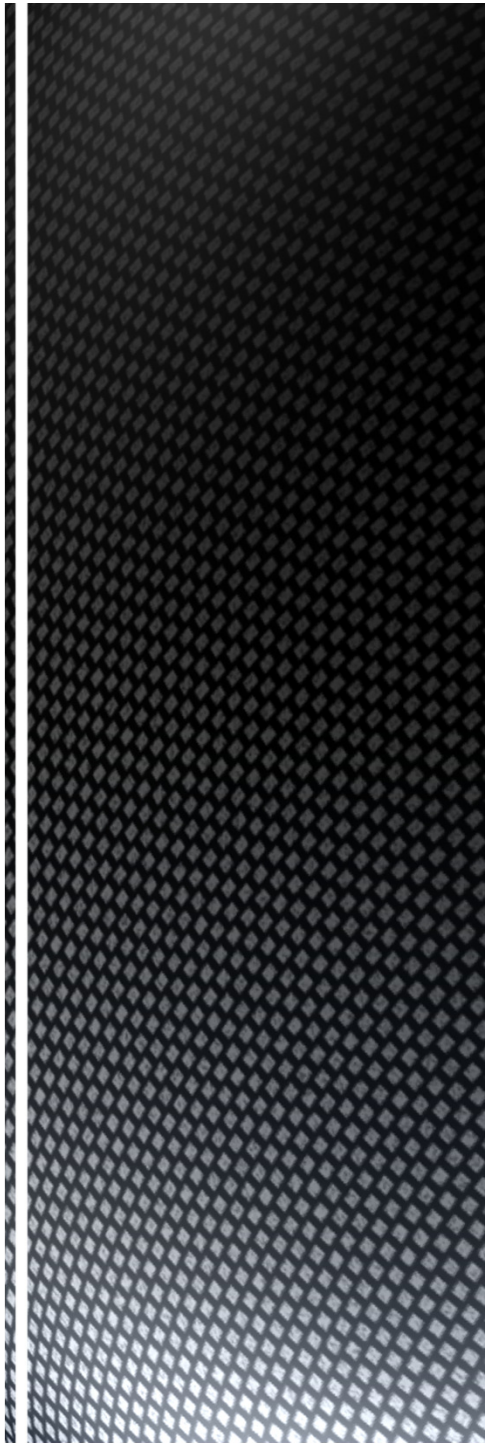


Linearity

the 888 remedies this:

Source: Ether, Chief Delphi

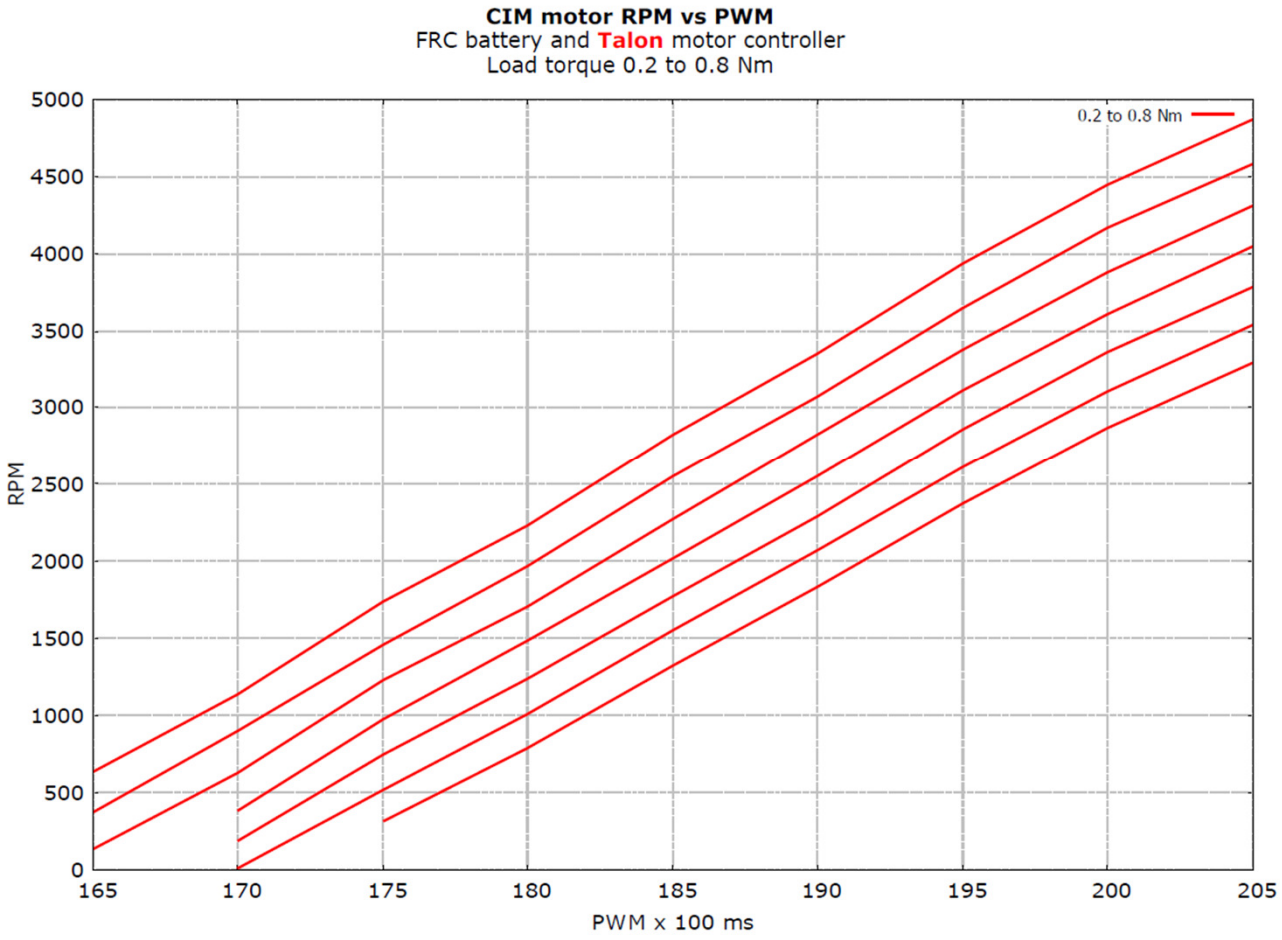


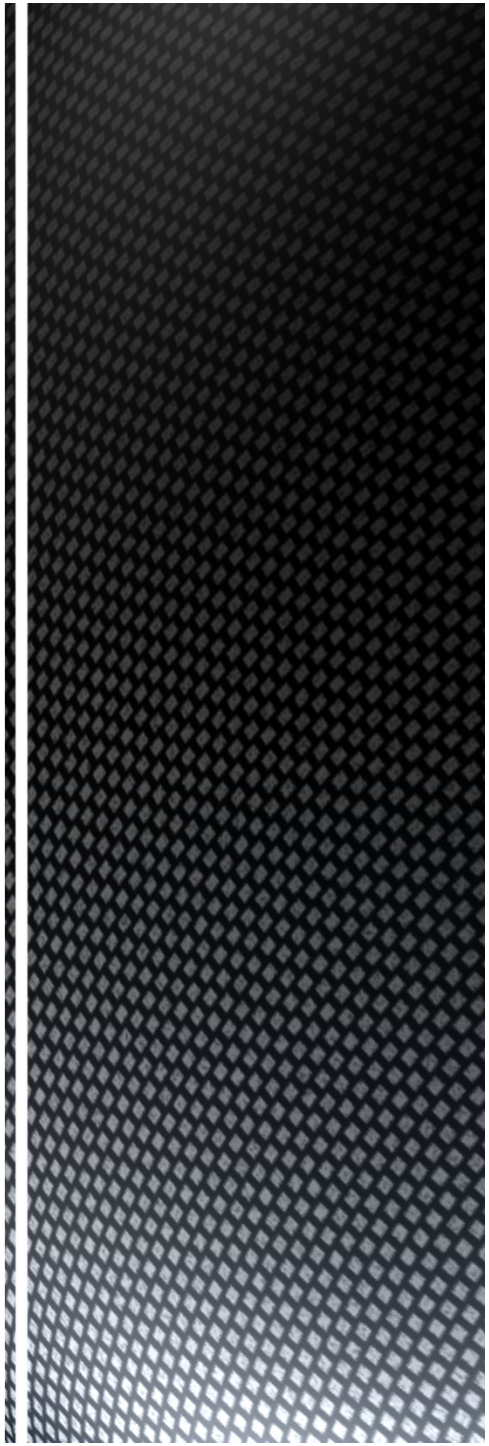


Linearity

but the Talon does as well:

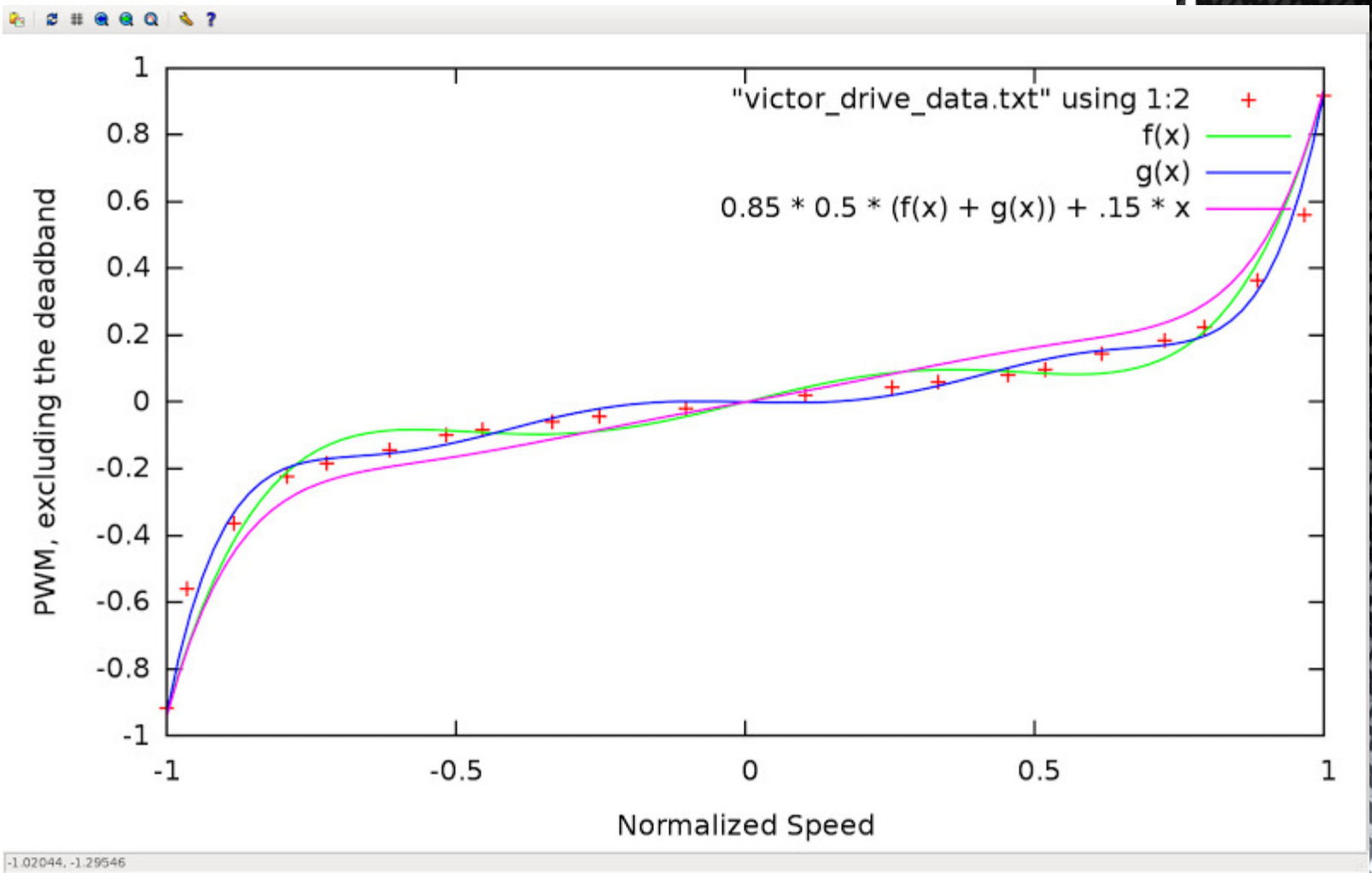
Source: Ether, Chief Delphi





Linearity

you can, however, work your own magic:



Source: Austin Schuh, former FRC254 The Cheesy Poofs