



Motorcycle Electronics & Control Systems

Philip Harris

Malcolm McDonald

School of Engineering

BEng (Hons) Motorcycle Engineering

Introduction

When looking at motorcycle electronics the control strategies are not freely available to evaluate, and the only documentation lies in their operation. While the principles of strategies such as ride by wire, gear shift assist, launch control and traction control are known the actual knowledge of what is happening within the hardware is a secret. The most open platform that can be investigated outside of an OEM are ECU manufacturers such as MoTeC or MecTronik, but these come at a substantial cost that is often not affordable for the user.

Project Aims

- Research current available strategies and solutions
- Establish an affordable development platform that can be easily be replicated, enhanced and improved
- Develop RBW (ride by wire) conversion for a conventional motorcycle
- Develop control strategies to take advantage of the RBW function

Methodology

Carefully researching and evaluating the development of motorcycle electronics alongside potential accessible hardware development platforms

Using Arduino hardware and affordable sensors an affordable development platform can be created.

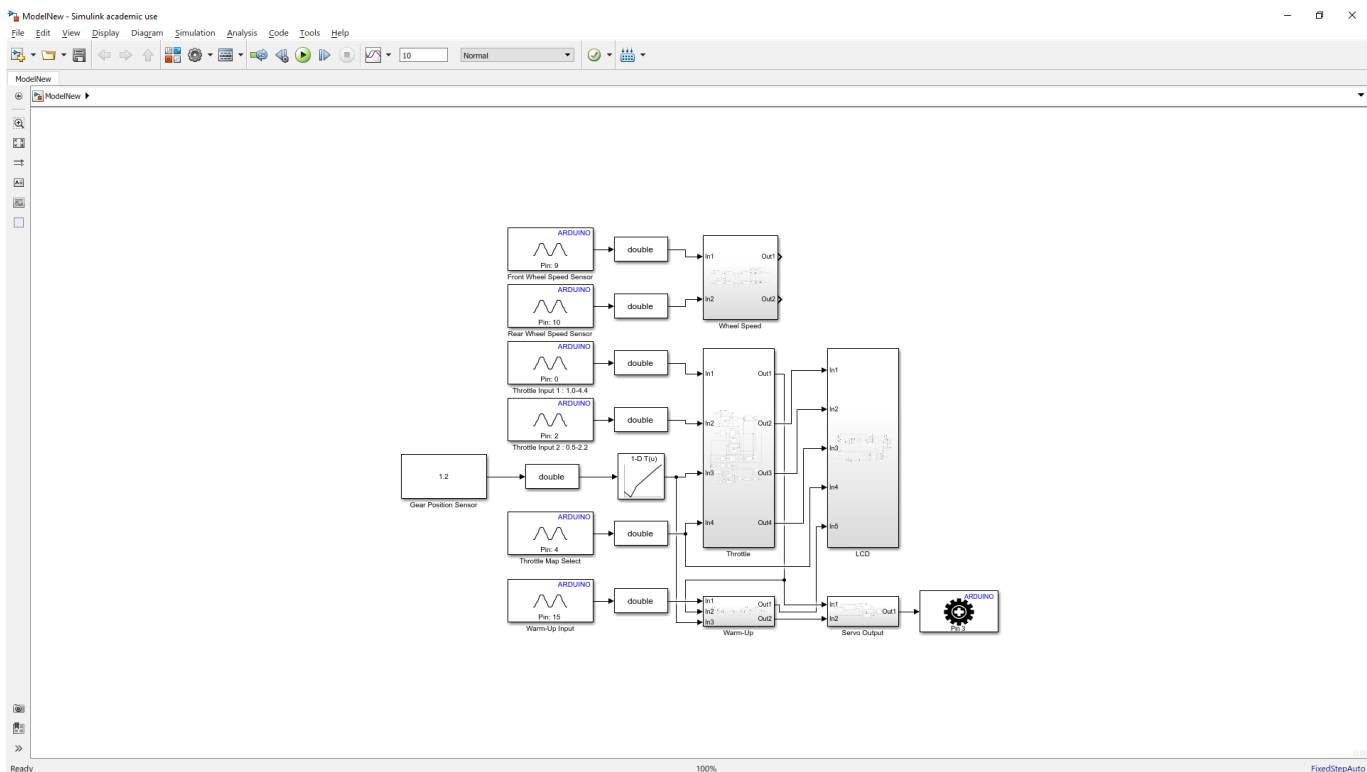
Simulink provides a feature rich graphical programming environment for modelling, simulating and analysing dynamic systems.



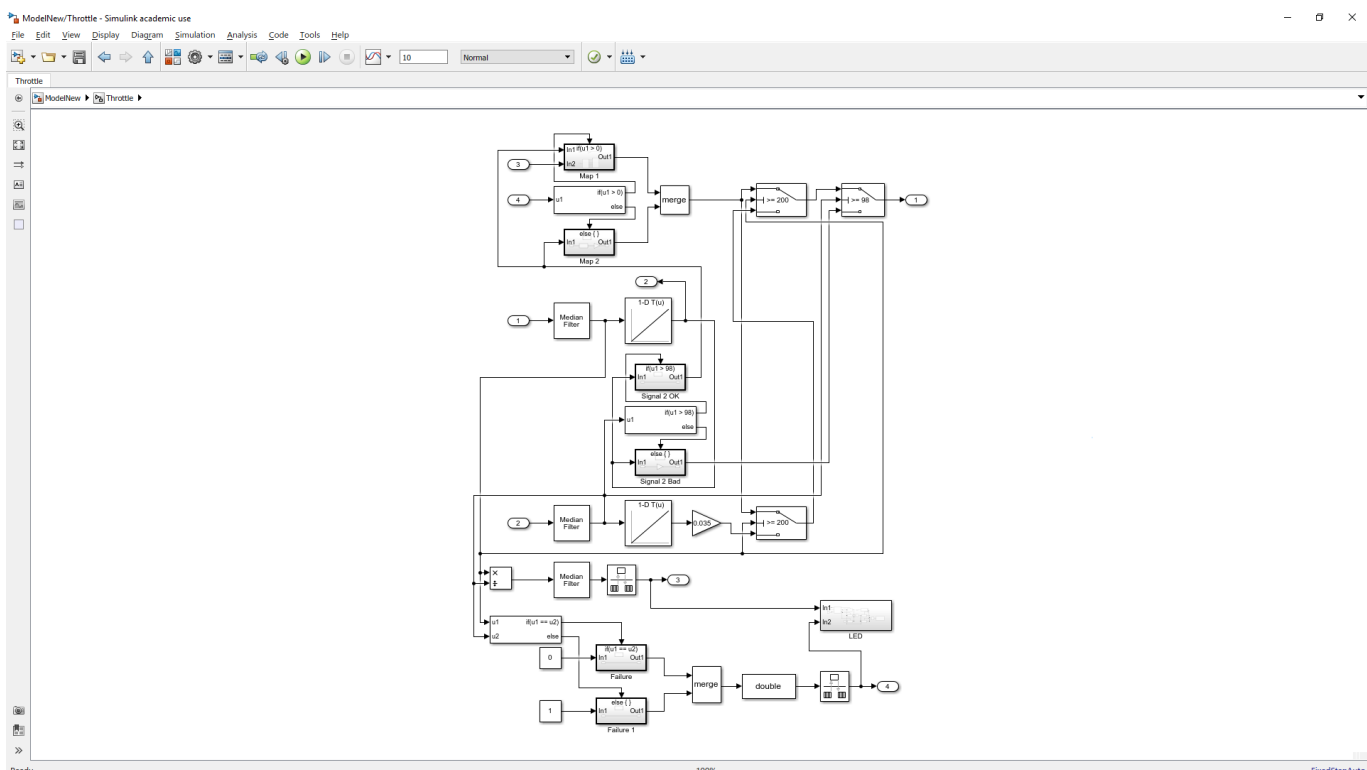
Arduino Mega 2560 Rev 3 [1]

Results

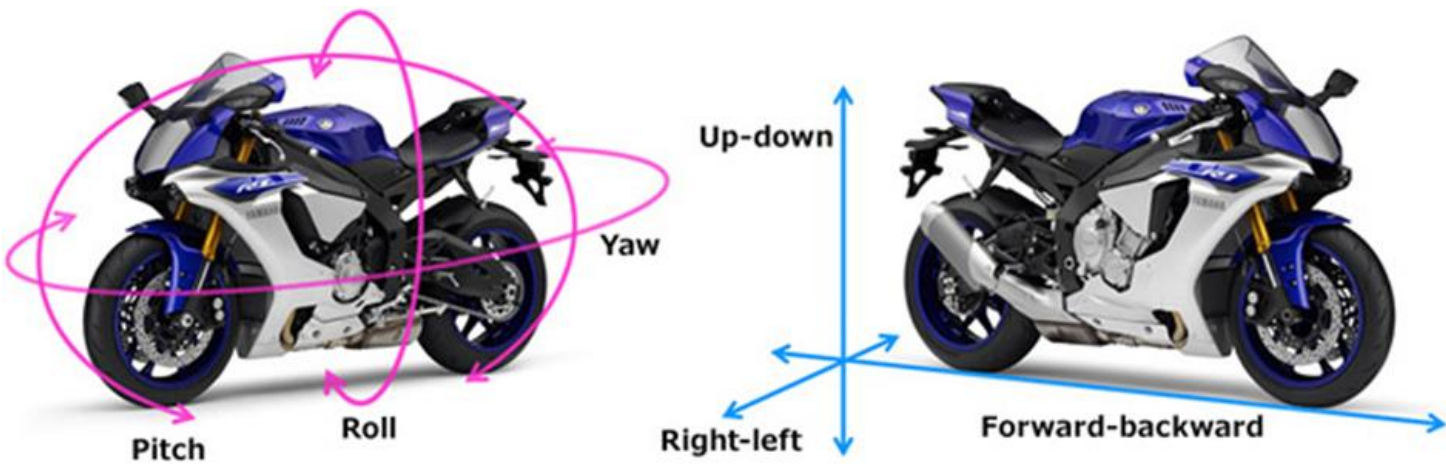
Through careful research, hardware has been specified and an initial Simulink model developed that captures the original aims of the project.



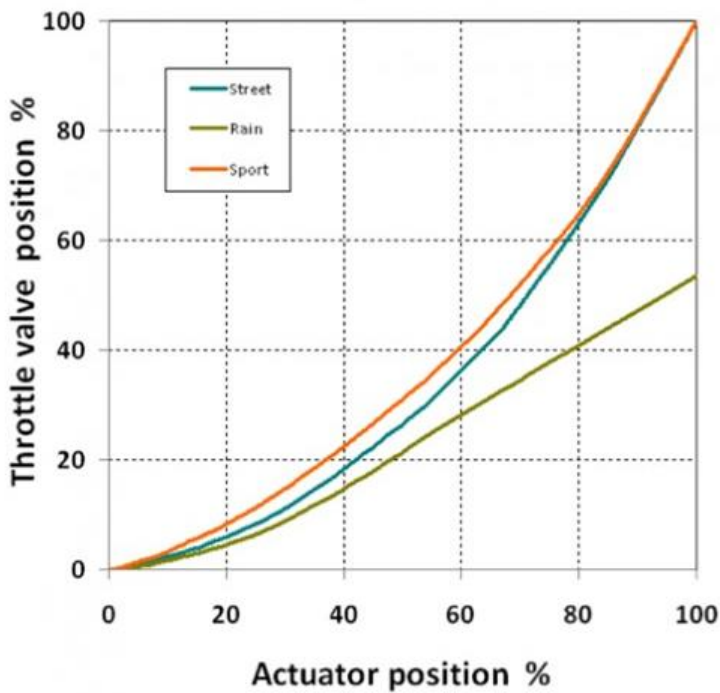
Simulink Model - Overview



Simulink Model – Throttle Subsystem



Motorcycle yaw, pitch, roll [2].



KTM 1290 Super Duke R Throttle Maps [3].

Conclusions

The current model is still very much in its infancy in terms of development and requires further enhancement and refinement. Each system has been built independently and then integrated, this has created some overlap and needs to be addressed as with more features and systems added this will only get worse in time.

The current model is not without limitations.

- No TPS feedback to verify servo position
- Software Median Filter (introduces a small latency within the system)
- No error code reporting structure
- Wheel speed does not consider lean angle variable (tyre circumference decreases with increased lean angle)
- Warm-Up subsystem has no coolant temperature input
- LCD driven direct, could be updated to I²C and reduce wires from 12 to 4

As development proceeds these limitations would continue to be identified and phased out, some though such as the TPS could only be done via vehicle integration during real world testing. The progress shown so far is promising but highlights the amount of time required for software development in designing, programming and testing to ensure that standards are met. It's often easy to make a system work but becomes rather difficult when attempting to make a system work safely.

References

[1] Arduino, 2019. ARDUINO MEGA 2560 REV3. [Online]
Available at: https://store-cdn.arduino.cc/uni/catalog/product/cache/1/image/500x375/f8876a31b63532bbba4e781c30024a0a/a/a0/a000067_front_1_.jpg
[Accessed 24 April 2019].

[2] BikesMedia, 2017. Motorcycle Inertial Measurement Unit (IMU) Explained. [Online]
Available at: <https://www.bikesmedia.in/uploads/image/reviews/2017/july/motorcycle-intertial-measurement-unit-imu.jpg>
[Accessed 27 April 2019].

[3] Motorcycle.com, 2013. 2014 KTM Super Duke R Review – First Ride. [Online]
Available at: <https://www.motorcycle.com/manufacture/ktm/2014-ktm-super-duke-r-review-first-ride.html>
[Accessed 26 April 2019].