Formula Student

Electronics, Instrumentation & Controls - Guidance Notes for Teams

In designing a car for Formula Student, teams may wish to consider the use of electronics, instrumentation and controls.

Where integrated effectively with the mechanical components of the car they can contribute to the team's performance in a number of ways:

- Calibration of the engine
- Diagnosis of faults
- Analysis and Optimization of performance of chassis, engine etc
- Feedback to drivers on their performance

A wide range of usage has been seen in previous years so these notes are provided for guidance of teams in the selection and implementation of electronic systems. The basic components of a system can be defined as:

- Inputs: e.g. sensors/transducers
- Controls: e.g. computers and real time software
- Outputs: in-vehicle displays, data logging reports, actuators etc.

Points to be considered in each category are given below but as the answers to the 'input' questions will probably depend on the answers to the 'output' questions it is best to consider them as a whole:

<u>Inputs</u>

- What needs to be measured?
- What types of sensors are available?
- What criteria should be used for choosing a specific technology?
- What sample rate, signal conditioning and filtering is required?

<u>Controls</u>

- What kind of data logging/control unit is needed?
- What CPU throughput and memory is required?
- What ADC resolution?

<u>Outputs</u>

<u>In vehicle display (for benefit of driver during practice and event):</u>

• Can you see it from all angles? Under different lighting conditions
• If it's on the wheel can you see it during steering?
• How much current does it take?

Offloaded data and analysis:

• What analysis do you want to do?
• What is your process for using the data? E.g. do you predict behaviour and use the analysis system to verify that the predictions are correct?
• Are you going to use the measurements to change the setup and feed into changing the design of the car?

General Design Issues

The electronic systems are going to be used in a difficult environment and so the following should be taken into account:

What electrical power will be required?
• Have you designed cables with this in mind?

How stable should the reference voltage be?
• Have you considered ground drops? Have you considered interference from ignition coils, plug leads, alternators, telemetry etc?

Failure Modes and Effects Analysis (FMEA), e.g.
• Have you analysed what the robustness and reliability issues could be?
• What happens if there is a short circuit? What if something goes wrong?
• *IS ANY FAILURE MODE SAFE?*
• Have you evaluated the effectiveness of each item in terms of the added weight?

Have you paid attention to modular design?
• E.g. is the loom designed/constructed in relevant sections?

•Are the electronics and connectors appropriate in an environment characterised by vibration, heat, dirt, potential of water, oil etc?

• Is the system expandable as your requirements change?

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