Full Throttle Drivetrain Acceleration Model

with loss of traction (wheel slip), drivetrain friction, rolling resistance, and motor voltage drop due circuit resistance

Full C source code.

CSV output file can be directly imported into Excel for graphing acceleration, speed, distance, motor amps, and voltage at the motors vs time.

2nd-order numerical integration using Heun's Method.

friction/loss/voltage_drop model
- Kf = torque-dependent drivetrain friction torque losses (drivetrain efficiency fraction)
- Krv = speed-related rolling resistance force losses (carpet compression)
- Kro = misc constant force losses
- Rcom = circuit resistance common to all motors
- Rone = separate circuit resistance for each motor

Heun's integration
- 2nd order integration, superior speed and accuracy compared to Euler
- Heun's can use 0.01 time steps and be as accurate as Euler with 0.001 steps
- Heun's integration explained: http://calculuslab.deltacollege.edu/ODE/7-C-2/7-C-2-h.html

Full C source code
- the compiled executable writes to standard output
- redirect the output to "filename.CSV", which can be opened directly in Excel for graphing
- easy to edit the constants in the C code to reflect your drivetrain design
- easy to change the output format to target other graphing programs such as gnuplot[1]
- easy to write a "glue" script (BAT file) to automate the process of editing, compiling, running, and graphing

[1] highly recommended: www.gnuplot.info

Engineering units

- SI units used internally for simplicity of computation
- English-to-SI conversions provided in source code so user can enter constants in English units
- SI-to-English conversions provided in source code for outputs

Model assumptions

- full-throttle motor voltage is applied at t=0
- all weight-bearing wheels are driven
- equal weight distribution on all wheels
- all wheels have the same "slipping" state
- transition from "slipping" to "not slipping" occurs instantaneously[2]

In the source code I picked values for Kro, Krv, and Kf out of the ether. For an accurate model you will want to determine these experimentally for your drivetrain. ***It would be enlightening to have a discussion about accurate and simple tests that could be used to determine these constants.***

[2] with no energy transfer due to speed mismatch between vehicle and wheels