

【学生向け】Simulinkによる簡易自動車モデリング

Nobu Iijima
10月16日 (金)
16:00 –17:00

目的

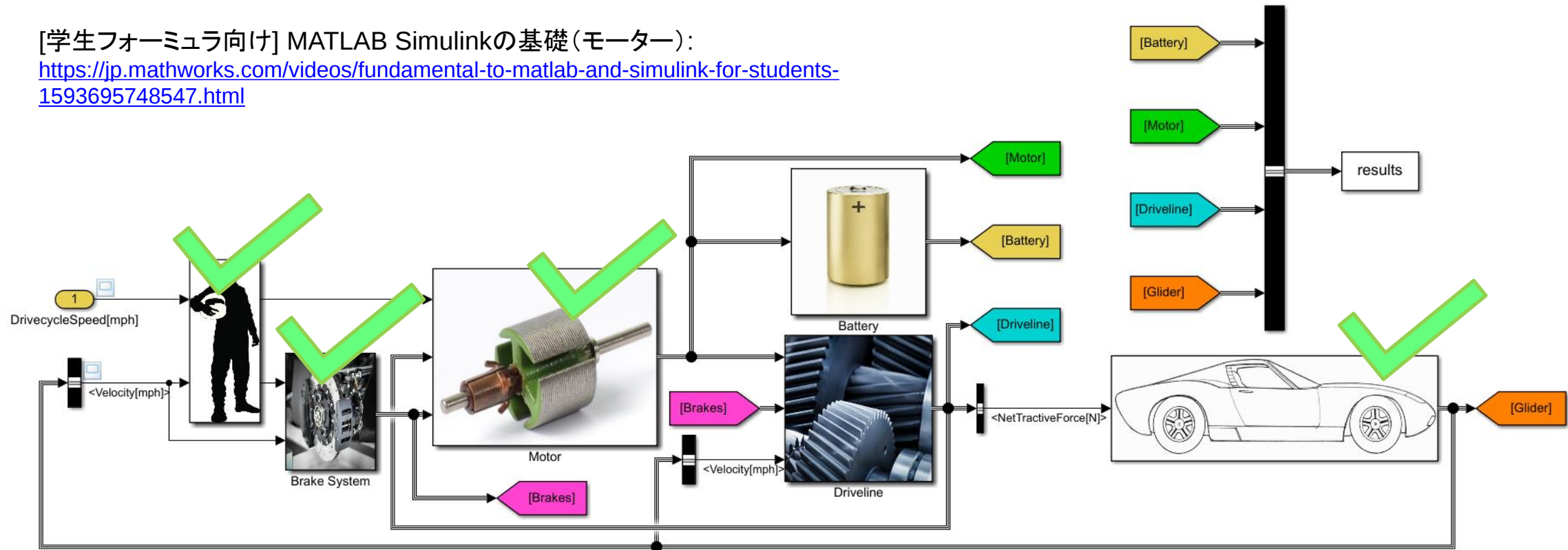
Battery Electric Vehicle モデルを理解

モデル:

<https://jp.mathworks.com/matlabcentral/fileexchange/63823-matlab-and-simulink-racing-lounge-vehicle-modeling>

[学生フォーミュラ向け] MATLAB Simulinkの基礎(モーター):

<https://jp.mathworks.com/videos/fundamental-to-matlab-and-simulink-for-students-1593695748547.html>

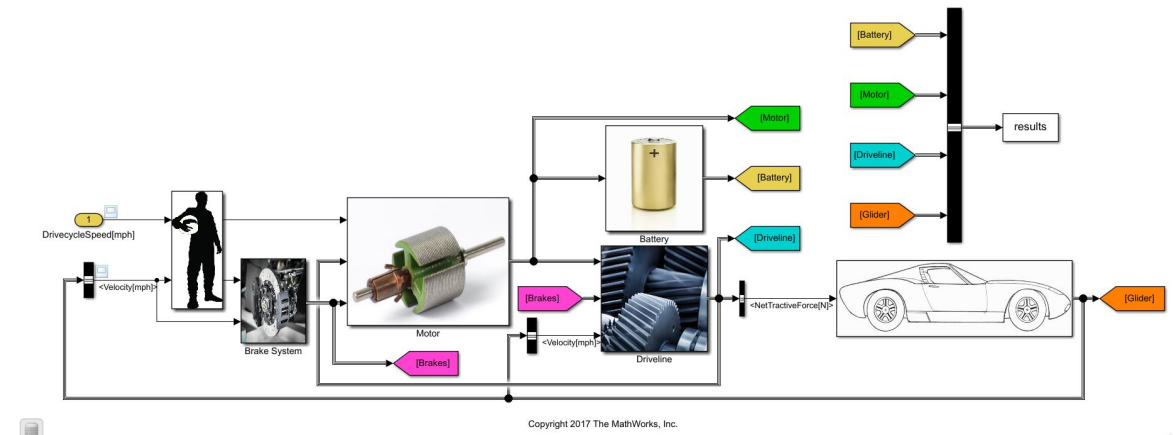
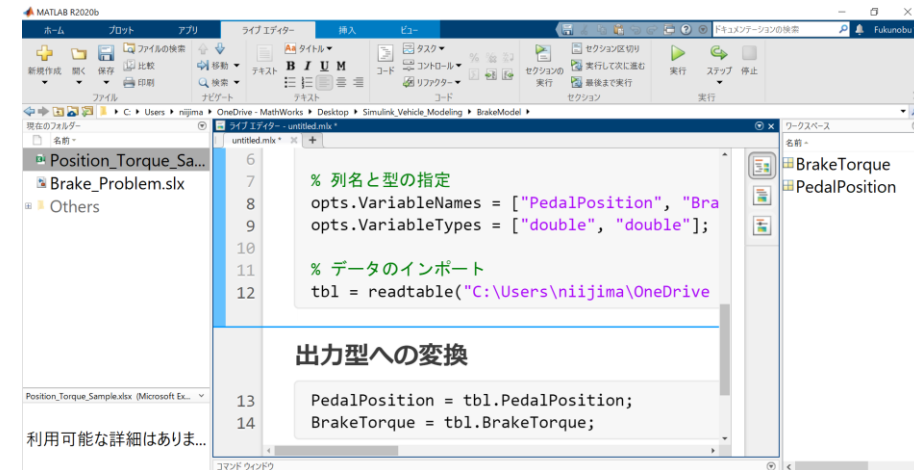


Agenda

- MATLAB、Simulinkとは？
- モデルベースデザインとは？
- デモ
 - MATLAB/Simulinkの基本操作
 - グライダープラントモデル/制御モデル/ブレーキモデル
 - BEVのモデル確認
- Resources と Q & A

MATLAB、Simulinkとは?

- MATLAB
アルゴリズム開発、データ解析、可視化、数値計算のための統合開発環境
- Simulink
システムの設計やシミュレーション、テストのためのブロック線図の環境
 - モデルベースデザインのプラットフォーム

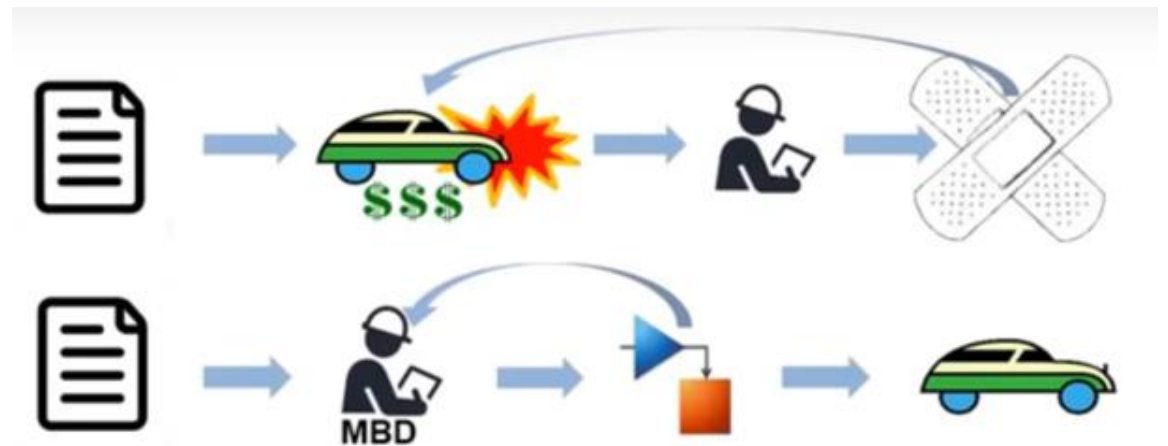


モデルベースデザインとは？

◇ モノづくりの際に、PC上でモデルを使って設計を進める手法

メリット:

- ・ 実機を製作するよりも安価で開発期間が短く、費用対効果が高い
- ・ 様々な試作品の性能を組み合わせて分析や最適な設計がバーチャルにできる
- ・ 数式や実験データがあれば、PCだけで開発ができる



[デモ] MATLAB と Simulinkの基本操作

デモ内容

MATLAB:

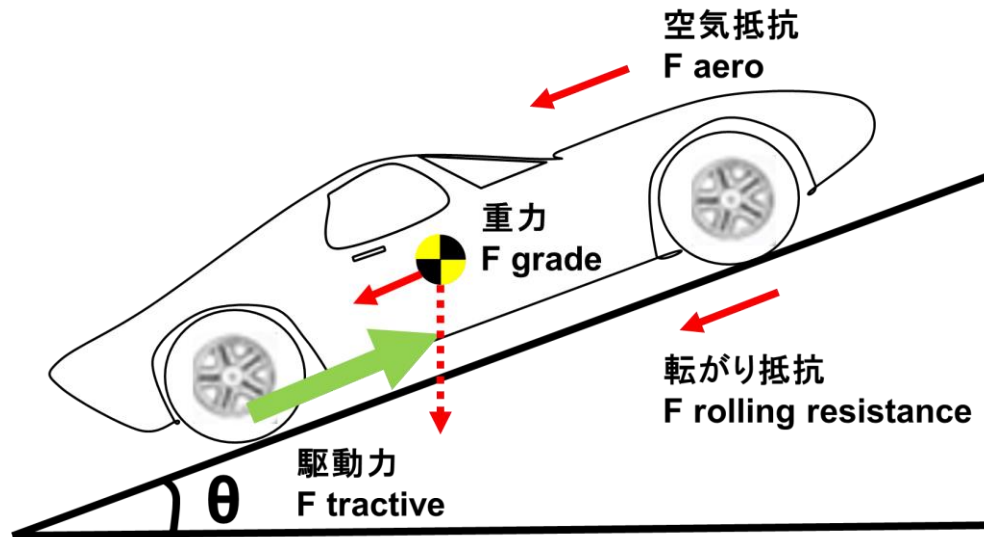
- GUI (3 windows)
- 四則演算

Simulink:

- Blockの説明と入手方法

グライダーモデルの説明

- 力(F_{tr}) が与えられている時の速度(V)を求める



$$F = ma$$

$$a = \frac{F}{m}$$

$$V = \text{integrate}\left(\frac{F}{m}\right)$$

$$V = \text{integrate}\left(\frac{1}{m} * (F_{tractive} - F_{aero} - F_{grade} - F_{rolling resistance})\right)$$

$F_{tractive}$: エンジン、モーターの駆動力

F_{aero} : 空気抵抗

F_{grade} : 坂道による重力

$F_{rolling resistance}$: 転がり抵抗

[デモ] グライダーモデル作成

目標:

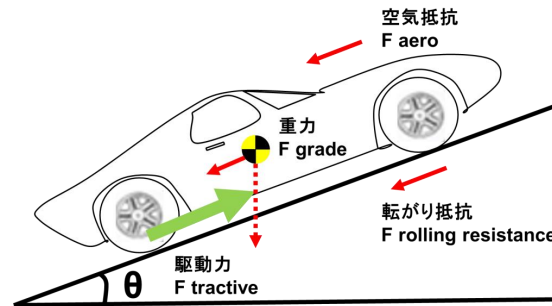
力(F_{tr})[N]が与えられている時の速度(V)[m/s]を求める

デモ内容

Simulink:

- 四則演算
- 積分
- 2乗 (square block)

$$V = \text{integrate} \left(\frac{1}{m} * (F_{\text{tractive}} - F_{\text{aero}} - F_{\text{grade}} - F_{\text{rollingresistance}}) \right)$$



$$F_{\text{tractive}} = 1000 \text{ [N]}$$

$$F_{\text{aero}} = \frac{\text{airDensity} * \text{aeroDragCoeff} * \text{frontArea}}{2} \times V^2 = 0.4908 \times V^2 \text{ [N]}$$

$$F_{\text{RollingResistance}} = \text{massVeh} * \text{gravity} * \text{rollingResistCoeff} = 225.6 \text{ [N]}$$

$$F_{\text{grade}} = \text{massVeh} * \text{gravity} * \sin(\text{inclinationAngle}) = 0 \text{ [N]} (\theta = 0)$$

$$m = 2392 \text{ [kg]}$$

[デモ] PID制御モデルの作成

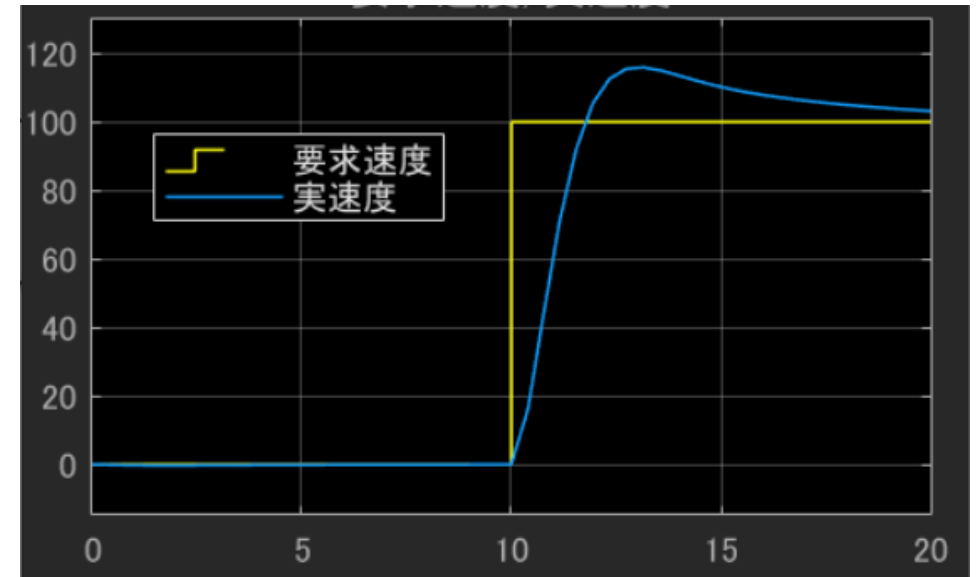
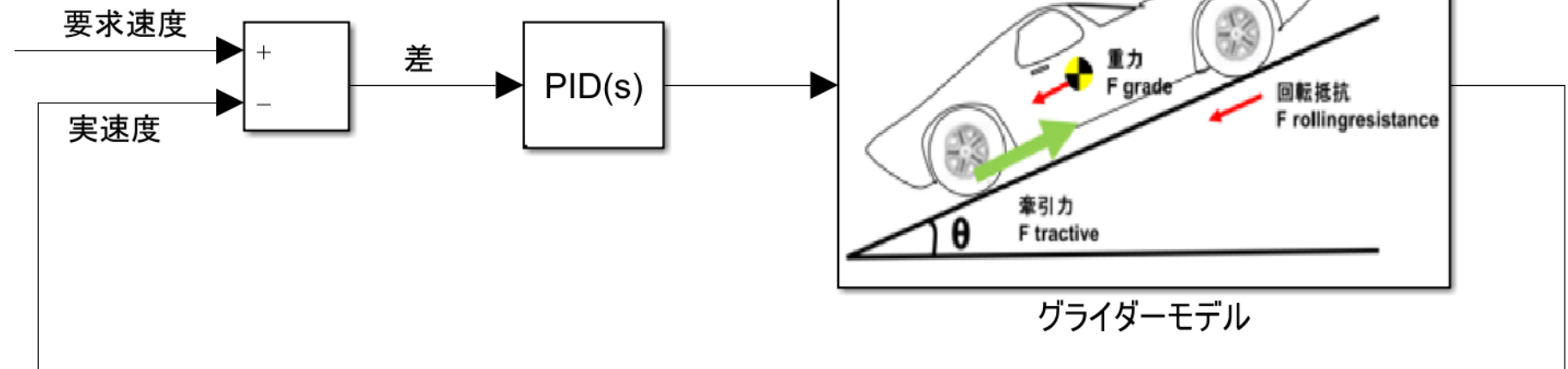
目標:

PID制御を用いて実速度を目標速度に近づける

デモ内容

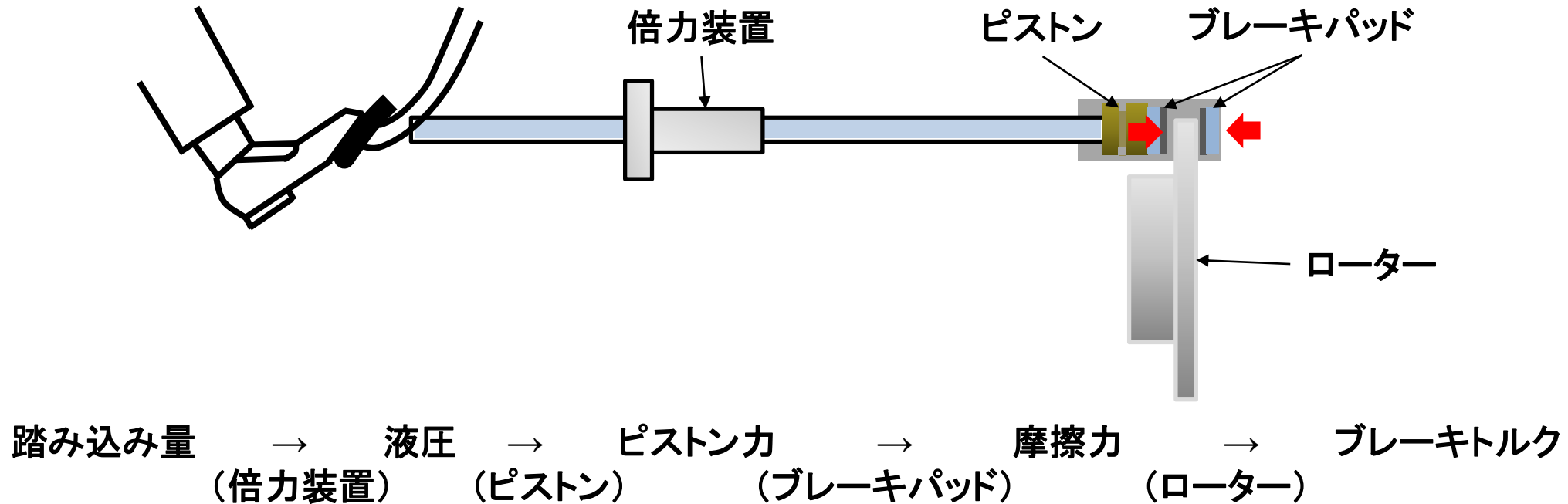
Simulink:

- PID Block
- Step



ブレーキモデルの説明

- 踏み込み量[%]が与えられている時のトルク(T)を求める



[デモ] ブレーキモデルの作成

目標:

Lookup Tableを用いて踏み込み量[%]が与えられている時のトルク[Nm]を求める

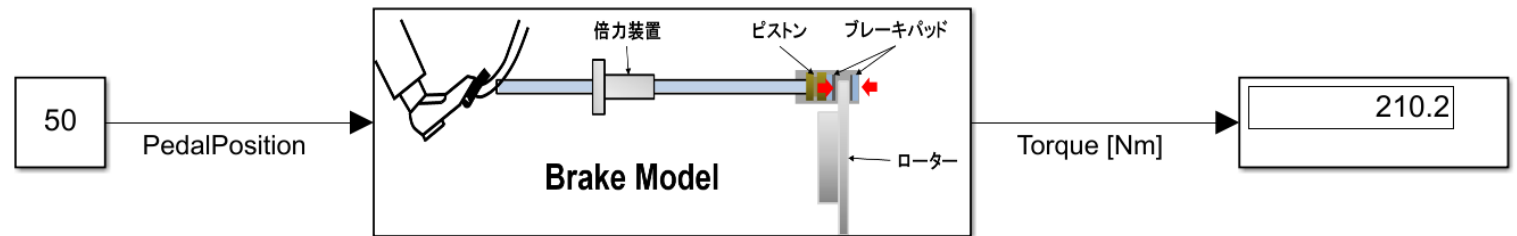
デモ内容

MATLAB:

- GUI (3 windows)
- Excel Fileの読み込み

Simulink:

- Lookup Table
- Switch block



踏み込み量 [%] → ブレーキモデル → ブレーキトルク [Nm]



自己学習コンテンツ

■ BEVモデル:

<https://jp.mathworks.com/matlabcentral/fileexchange/63823-matlab-and-simulink-racing-lounge-vehicle-modeling>

■ MATLABとSimulinkの基礎 (モーターとサスペンション):

https://www.youtube.com/watch?v=XrMpZWW2gic&t=215s&ab_channel=MATLABJapan

■ ルックアップテーブルの使い方:

https://www.youtube.com/watch?v=iS6ePvyoyY&t=5s&ab_channel=MATLABJapan

DCモーターのモデリングと制御

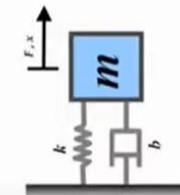
モデル:



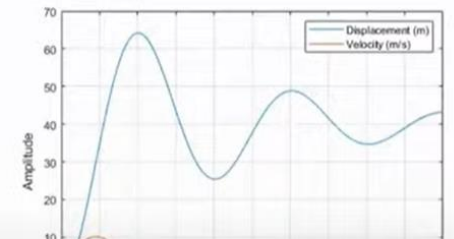
バネマスダンパーモデル



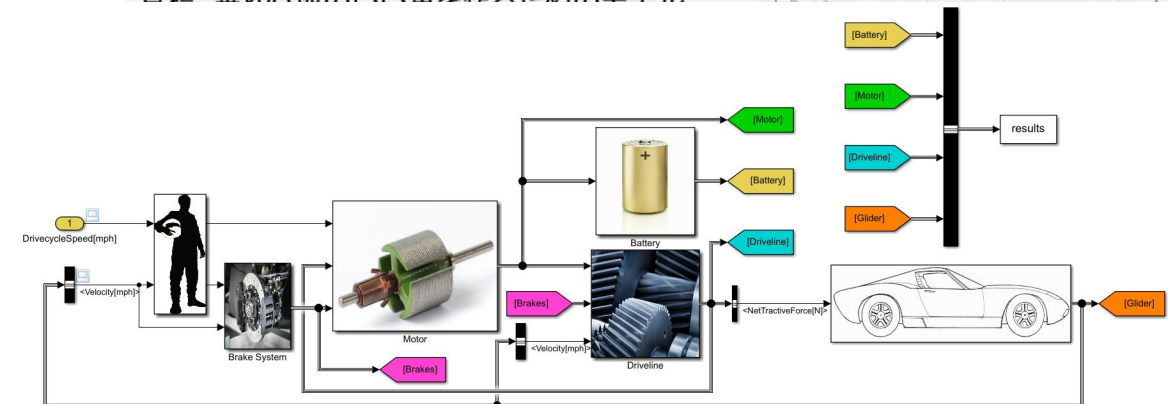
モデル: サスペンション



目
既
解



目標・垂い心・...のモデル



上位入賞者インタビュー

■ The Winners Circle:

<https://www.mathworks.com/academia/superstar-students.html>

■ NHKロボコン記事:

<https://pc.watch.impress.co.jp/docs/news/1094591.html>

■ Minidrone Competition:

<https://monoist.atmarkit.co.jp/mn/articles/2007/01/news001.html>

The Winner's Circle

Cool projects. Raw talent. The right tools. With these ingredients student competition teams are winning competitions worldwide and shaping the future of automotive design, aerospace engineering, robotics, and many other technical fields.

Get support for your team



Robotics

Automotive



Osaka University

1st Place - Student Formula

Osaka Univ. Formula in the Student Formula. They made a four-wheel vehicle and simulated different steering and the optimal length of car would remain stable for five seconds.

- » Team Website
- » Team Facebook
- » Team Twitter



Government College of Engineering Aurangabad

MathWorks Modeling Award- DD ROBOCON India 2019

We used MATLAB & SIMULINK for

- Modelling and Simulation of Dynamic behaviour of autonomous robot
- Analysis of gaits and the algorithms for autonomous robot
- Designing the control system.
- Calculating trajectory of Shagol with different angles and velocities for manual robot
- Transition of autonomous robot to different zones according to color of zone.

- » Our facebook page
- » Our Instagram page



Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)

2nd Place - Soccer Small Size League RoboCup 2019

ER-Force is a RoboCup Soccer Small Size League team that came in second place in this year's international event in Sydney, Australia. They used MATLAB to develop, simulate, and optimize their motion control systems for their autonomous soccer robots.

Efficient and precise motor control is crucial in the competitive RoboCup environment and



Eindhoven University of Technology

1st Place - Soccer Middle Size League RoboCup 2019

Tech United, the robot soccer team from Eindhoven University of Technology, won 1st Place in the RoboCup Soccer Middle Size League 2019 in Sydney, Australia. The team uses MATLAB and Simulink to develop and generate real-time control software for their robot soccer players. This allows the team to rapidly develop complex software, ranging from vision to real-time motion control to strategy software.

- » Team website
- » Watch a recap of the final match



Shattuck Public School

2nd Place BEST Award - Frontier Trails BEST Regional Robotics Championship 2018

The team at Shattuck Public School used Simulink to provide a simulation of their robot structures to help them design and build an effective robot. This year's goal was to build a robot that might help clean up the oceans, and it was an exciting challenge.



Technische Universität Graz

2nd Place - Logistics League RoboCup 2019

Team GRIPS achieved 2nd place at the RoboCup Logistics League competition 2019 in Sydney. MATLAB and Simulink were used in the parameter tuning process for several control loops. The team plans to integrate MATLAB even more in the software stack by connecting to the Robot Operating System (ROS). This will enable the team to conveniently implement more sophisticated control algorithms.

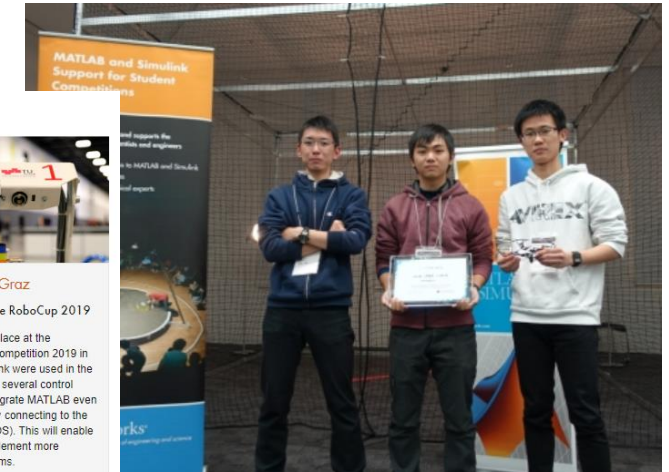
- » Team GRIPS Website
- » Team GRIPS Facebook page
- » RoboCup Logistics League



Eastwood/Cornerstone Schools, Montgomery, AL

3rd Place Game Winners - South's BEST Regional Robotics Championship 2018

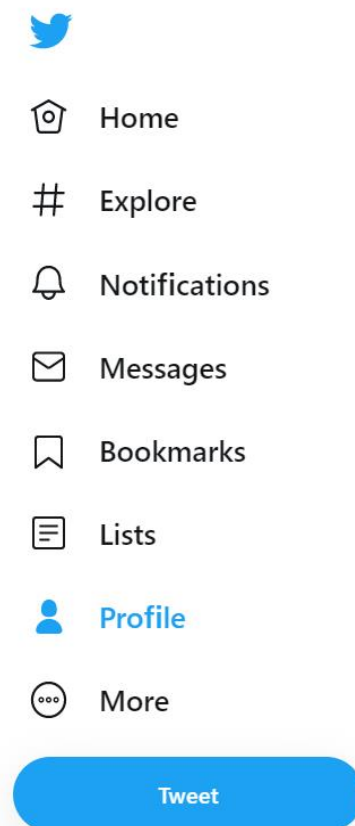
Gears, Inc. Robotics team, from Eastwood/Cornerstone Schools, won the Simulink Design Award at the South's BEST Regional Robotics Championship. They used Simulink and Stateflow to program their robot's drive and control functions, allowing it to collect trash from a simulated ocean environment. The award was given based on the design and sophistication of the Simulink model, as well as



Twitter アカウント

- NobuthWorks
<https://twitter.com/NobuthWorks>

- セミナーの告知
- 企業について
- 学生イベント



学生競技会に関するお問い合わせは

連絡先:

飯島福信 (Nobu Iijima)
学生コンテスト技術支援担当

Tel: 03-6367-6708

Email: niiijima@mathworks.com

Twitter: [NobuthWorks](#)

ご清聴ありがとうございます。

Q & A