Dataflow programming languages: Simulink

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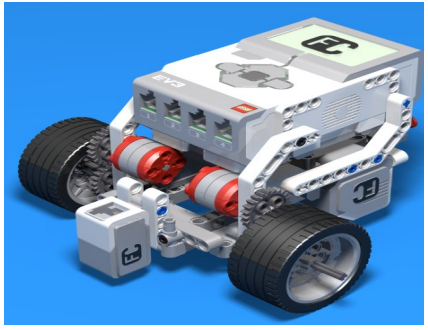
Simulink

Data-flow programming within MatLab, very engineering-oriented

PRO: Compile/deploy to many systems

Sapienza students licenses

- Android devices
- Apple iPhone/iPad
- Raspberry Pi
- Arduino
- Beagleboard



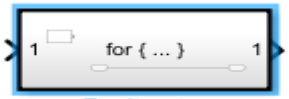
- Nao robot
- Xilink FPGA boards
- Lego Mindstorms EV3
- Parrot mini drones

Features

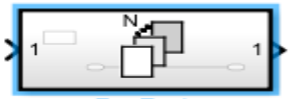
Typed wires?	YES	(but not visually)
Functions?	YES	(in Matlab or in Simulink)
Functional programming?	NO?	
Recursion?	YES	(but in Matlab only)
Loops?	YES	(for, foreach, while)
External languages?		
- Matlab, C, Fortran	YES	
- Python ecc…	YES	(through Matlab)
File I/O	YES	
Modularization?	YES	(subsystems)
Concurrency?	YES	(explicit partitioning)

Subsystems: looping constructs

While Iterator Subsystem



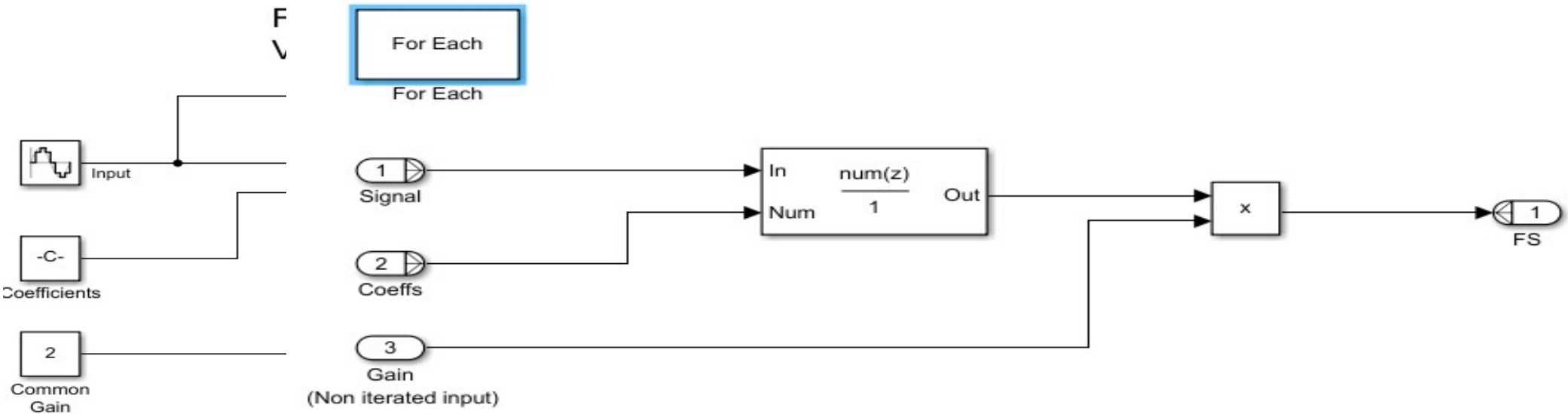
For Iterator Subsystem



For Each Subsystem

Subsystems are used for:

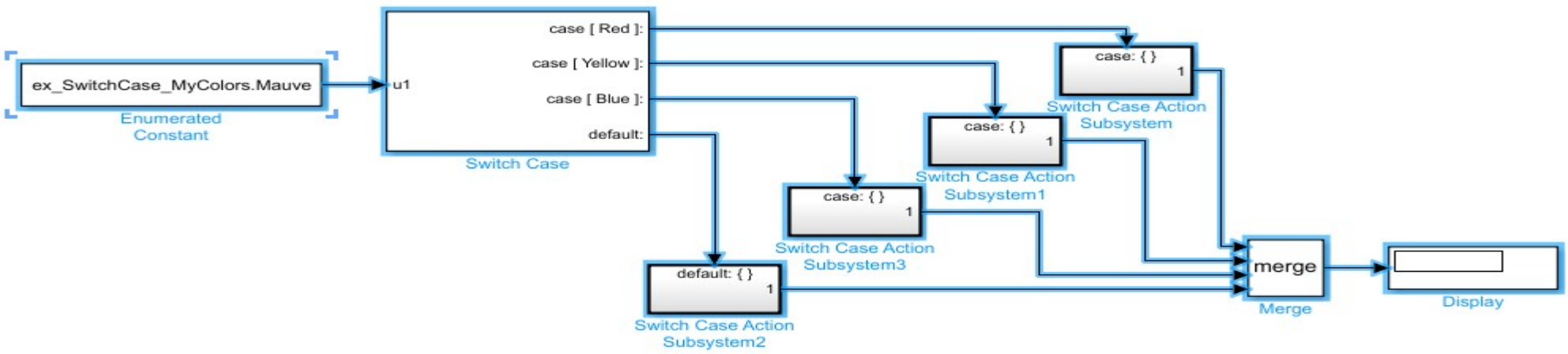
- **Hierarchical model definition (modularization)**
- **Repeated execution (for/while/foreach)**



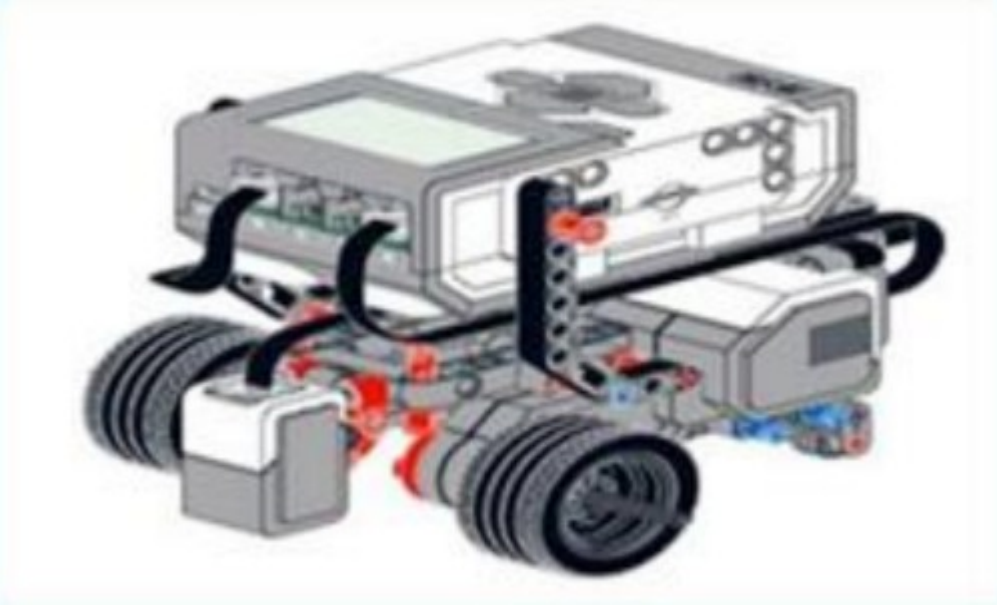
Conditionals: switch + merge

Conditional execution (if/case) is made by:

- **if/case block with tested input and “enable” outputs**
- **a separate circuit/subsystem for each case (with “enable” port)**
- **a merge block collecting all alternate outputs**

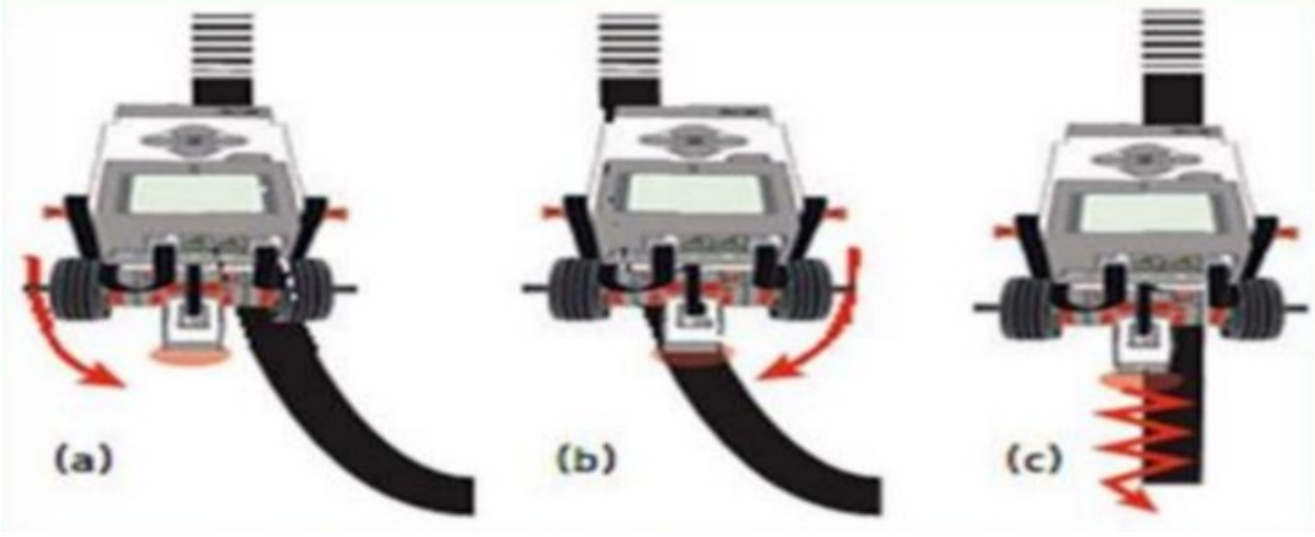


Lego EV3 line follower



EV3 with light sensor facing down

Follow the B/W border of the line



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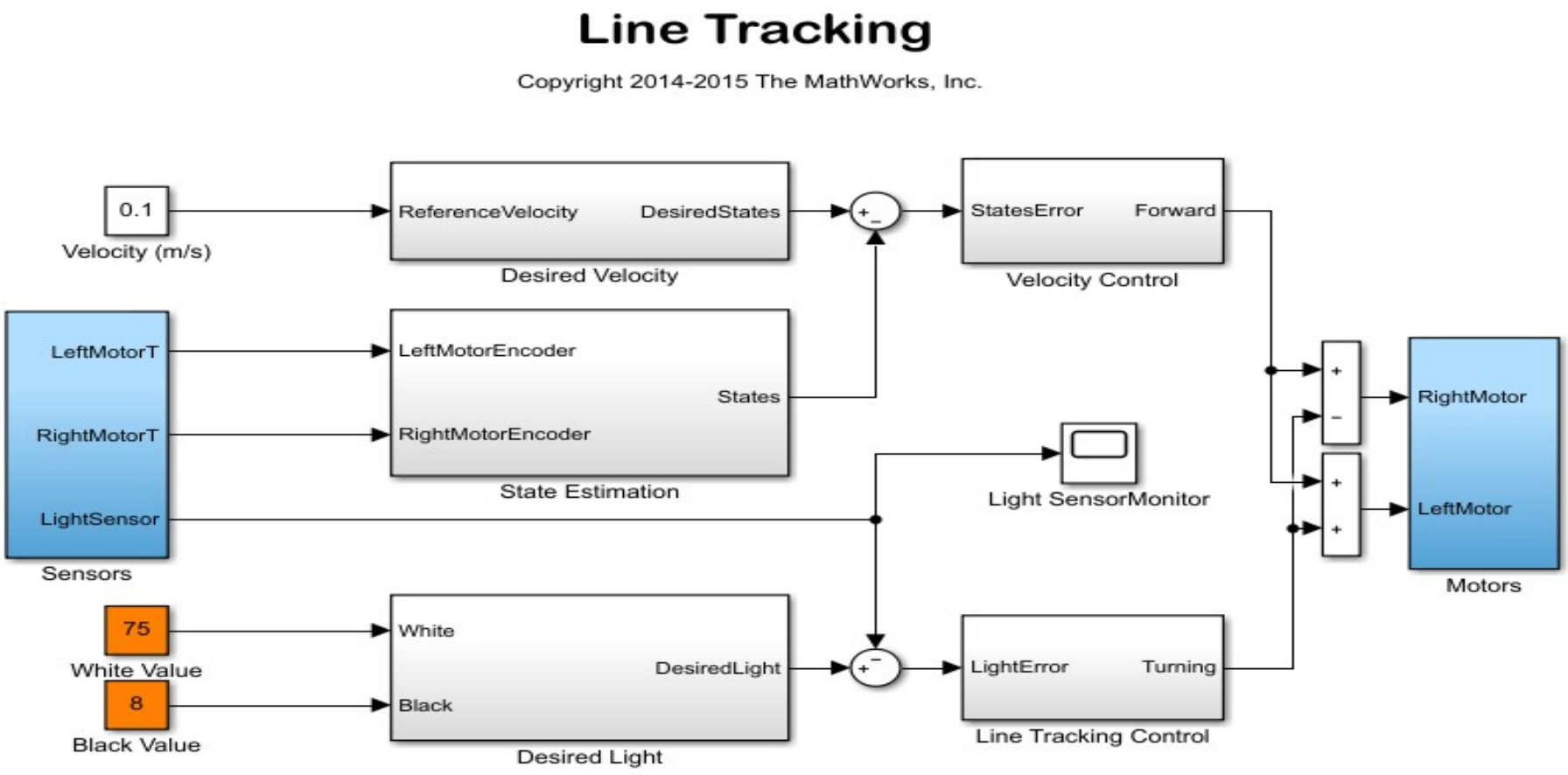
Line follower: control system



Line follower details

SIMULINK … loading

Lego Bike: keep a bicycle up by steering (@UNI-FI)

Sensors:

- gyroscope
- ultrasound distance
- front wheel angle
- rear wheel rotation

Actuators

- front wheel steer angle
- rear wheel speed
- rear stand up/down

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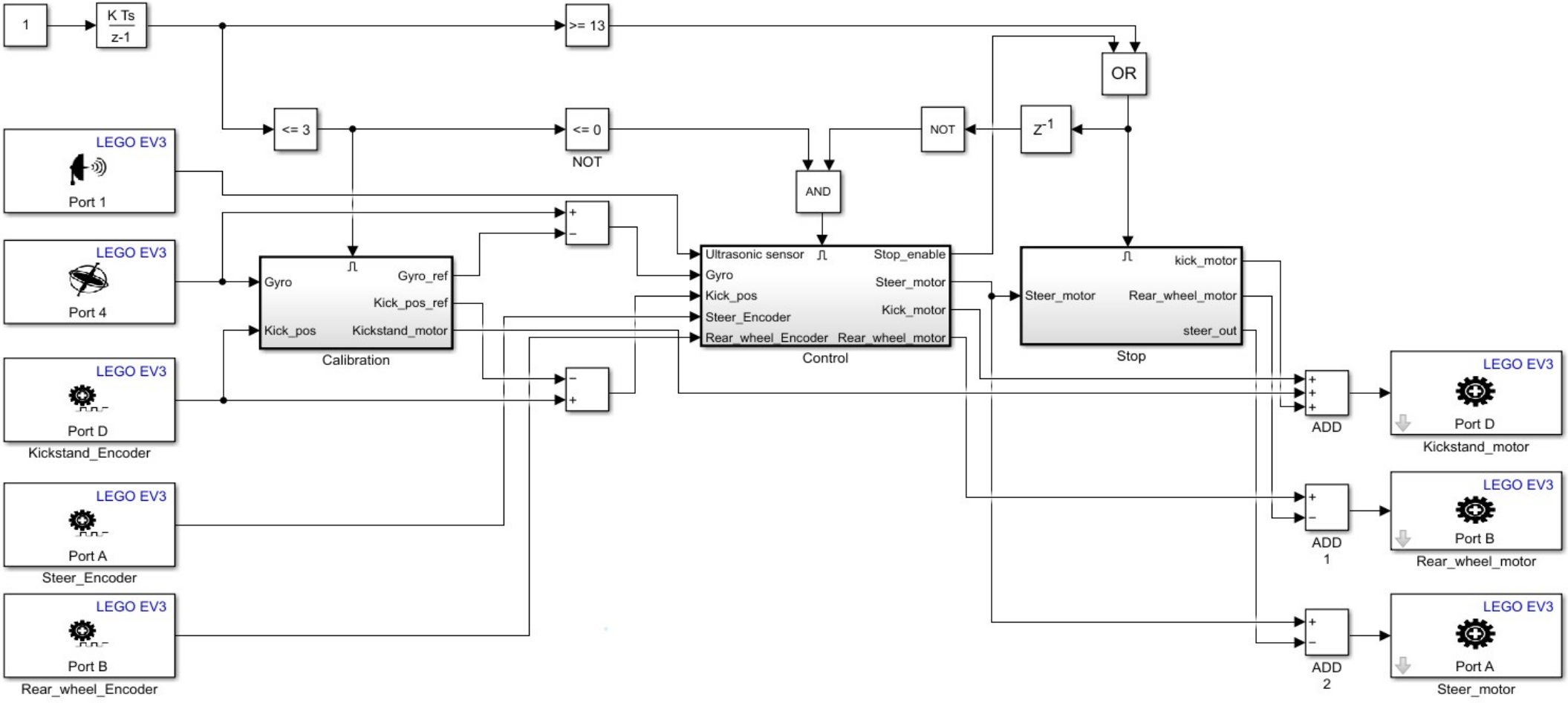
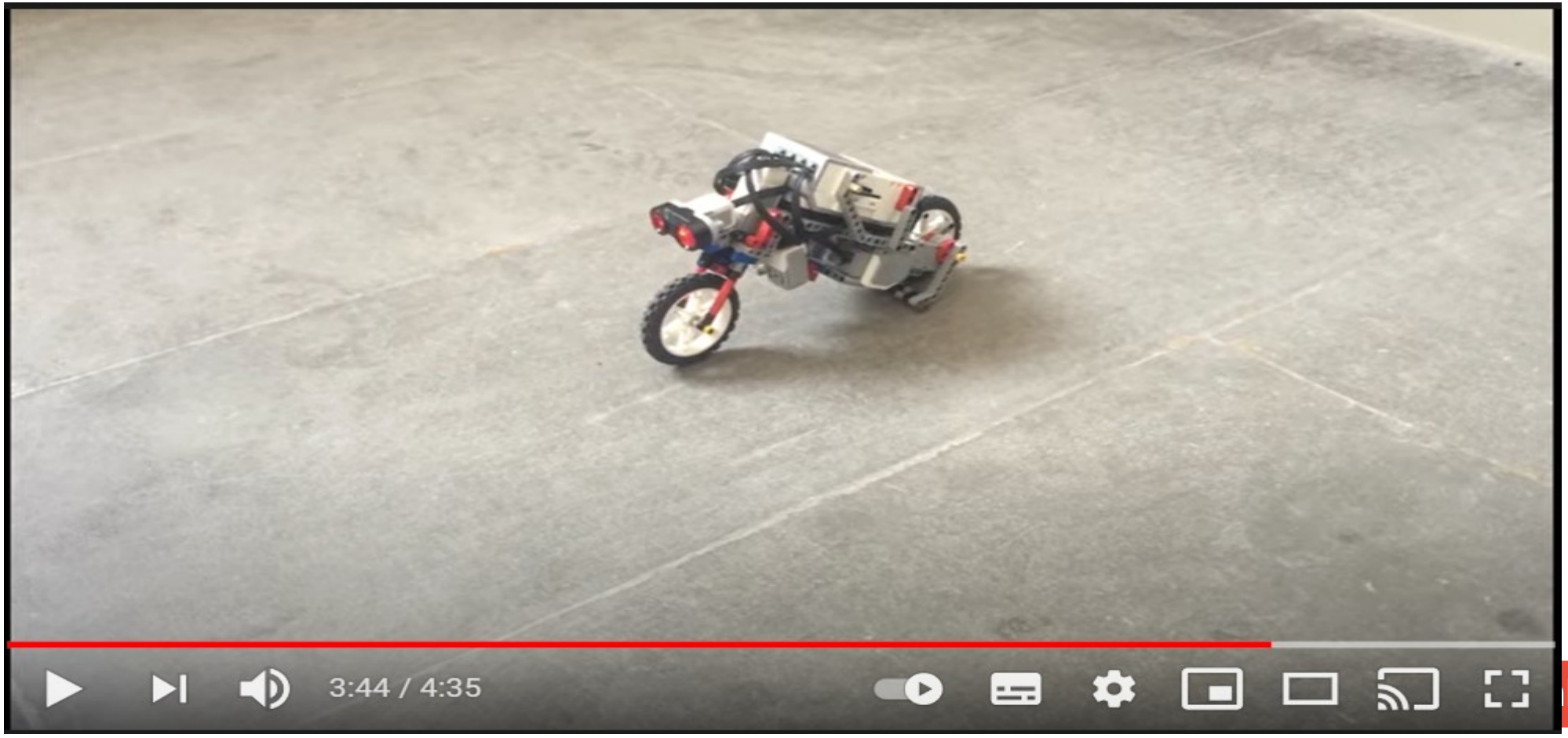
Lego Bike: control system



Lego Bike in action



Simulink for teaching Computational Thinking?

PRO

- algorithms as circuits
- enhance modularization with submodules
- good for data/signal analysis
- good for control systems
- a lot of packages and examples
- robotic simulation (ROS or Control toolbox)

CON

- algorithms as circuits (!)
- could be overwhelmingly complex
- diagrams less readable than LabVIEW
- exec. constraints not shown in diagrams

TLDR: good for electronic/technical schools