Hochschule Bremen
City University of Applied Sciences

MATLAB® SIMULINK® Exercise – Stick –Slip Effect

Modelling and Simulation 2022/2023 | MEAM 19

Bremen, 09.01.2023

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Problem Definition

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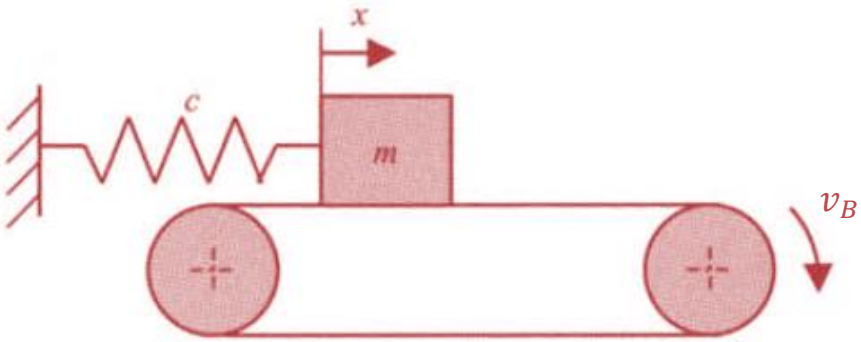
- Stick-Slip Effect: change between static friction and slide friction

- flat conveyor with load moves with v_B
- Spring with spring constant c
- Mass m is moved with conveyor until spring force > static friction
- Mass moves to the left due to the smaller slide friction force
- Mass rests and starts moving to the right



- -> nonlinear oscillation

1. Define the Friction Force F_R

2. Display the path and the speed over time of the mass m

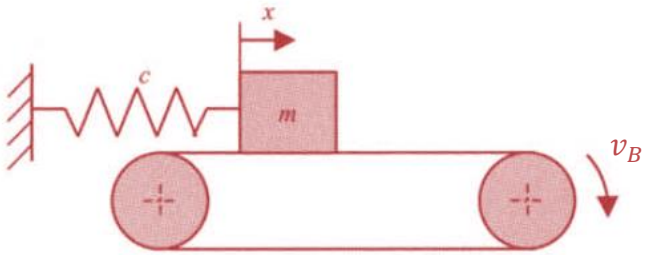
3. **Task list**

Problem Definition

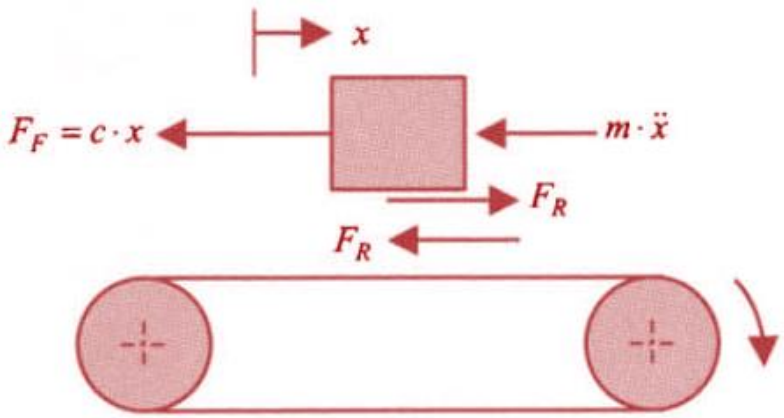
1. Display the way of the mass over time (Computational/ Simulation)!

Given:

Time Constant:	$Tv = 0.1\ \left[\frac{m}{s}\right]$
Speed of conveyor:	$vB = 0.1\ \left[\frac{m}{s}\right]$
Static friction:	$FHR = 10\ [N]$
slide/dynamic friction:	$FGR = 7\ [N]$
	$dF = FHR - FGR\ [N]$
Mass:	$m = 1\ [kg]$
Spring constant:	$c = 80\ [N/m]$



0. Prerequisite Equation of Motion



D'Alembert's principle: $m \cdot \ddot{x} = F_R - c \cdot x$

-> $\ddot{x} = \frac{F_R - c \cdot x}{m}$

Wanted: F_R

Solution

1. Defining of F_R

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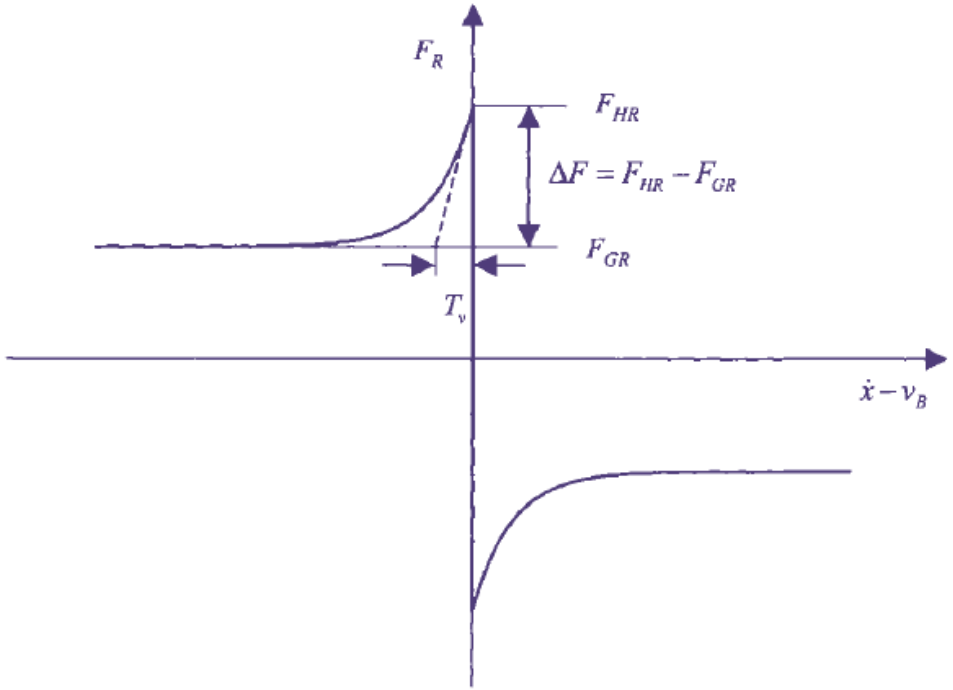
$$F_R = -sgn(\dot{x} - v_B) \cdot \left[F_{GR} + \Delta F \cdot e^{-\frac{|\dot{x} - v_B|}{T_v}} \right]$$

$$\ddot{x} = \frac{F_R - c \cdot x}{m}$$



Solution

2. Computational Solution

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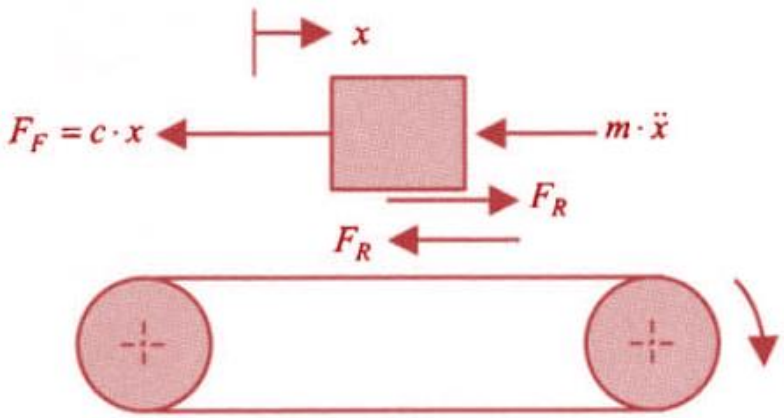

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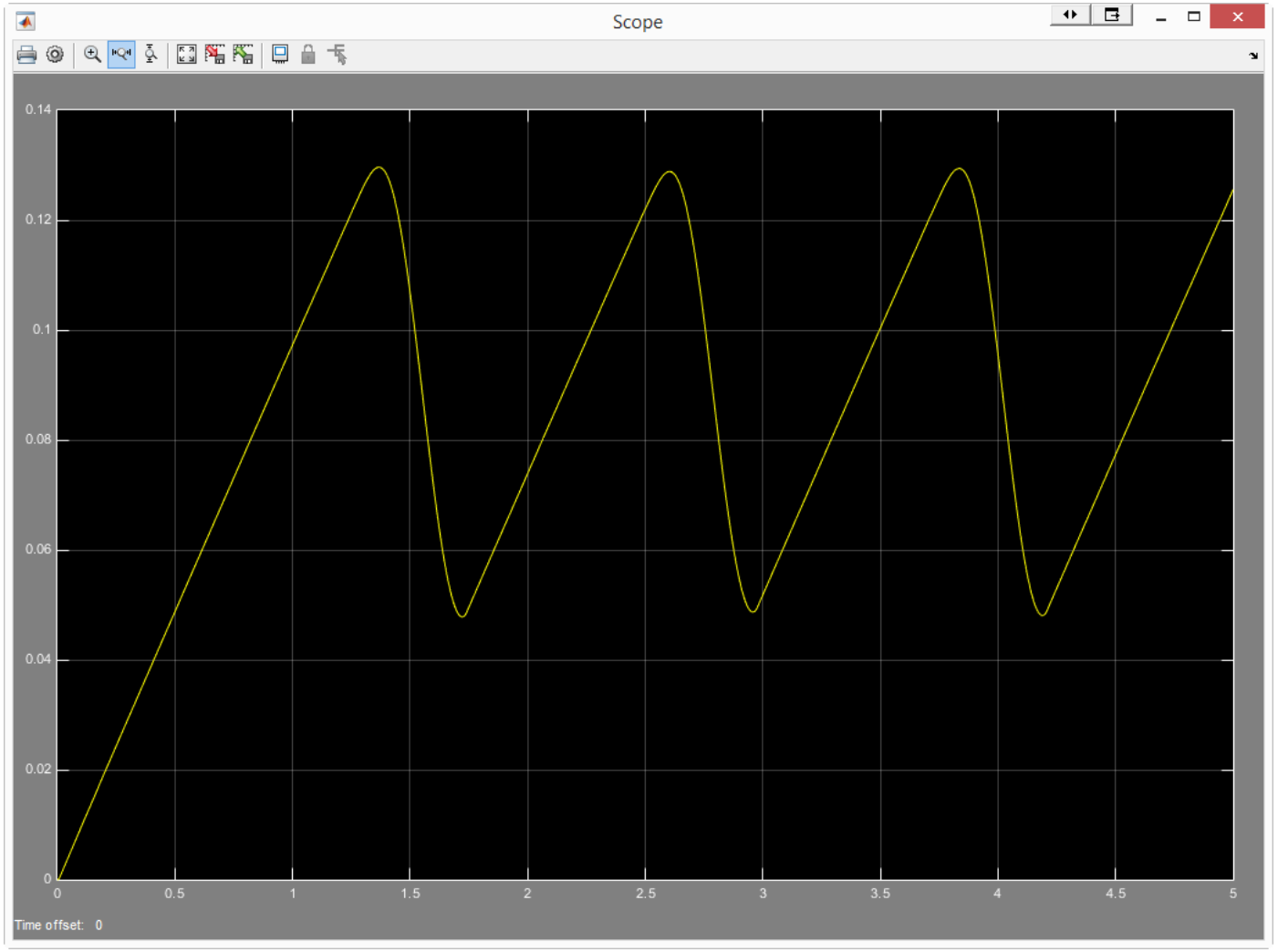
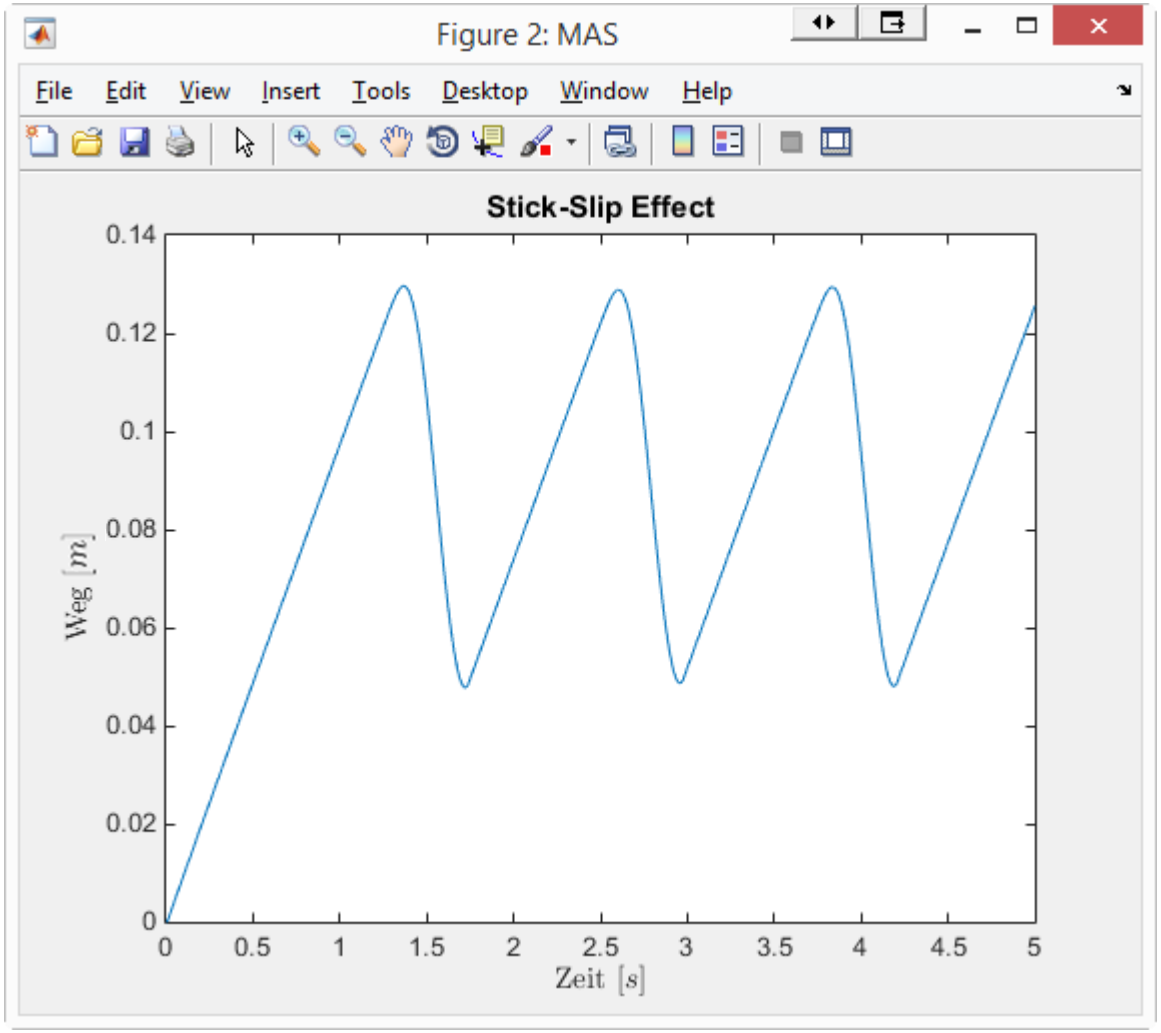
2. Computational Solution | Simulink Scope

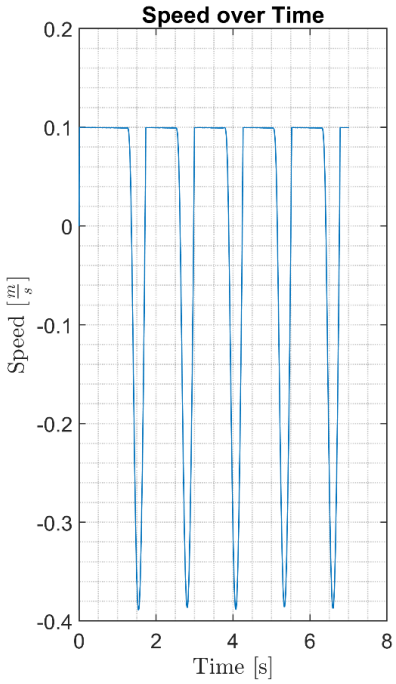


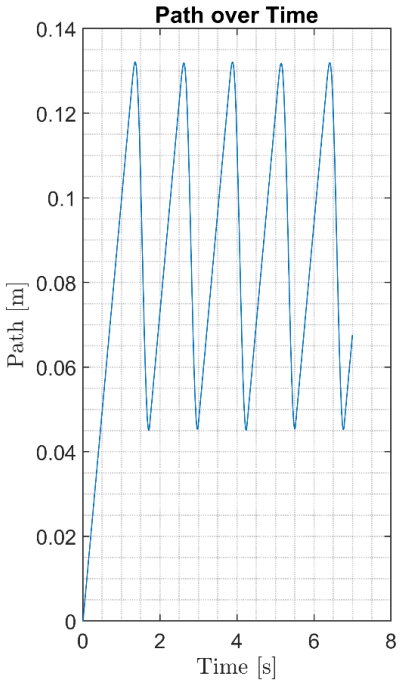
2. Computational Solution | Matlab Figure

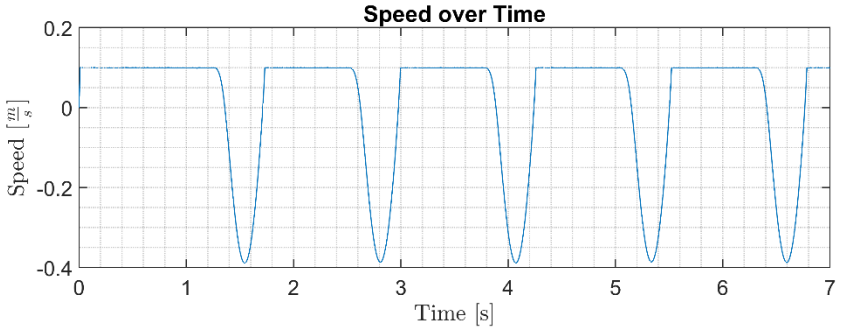


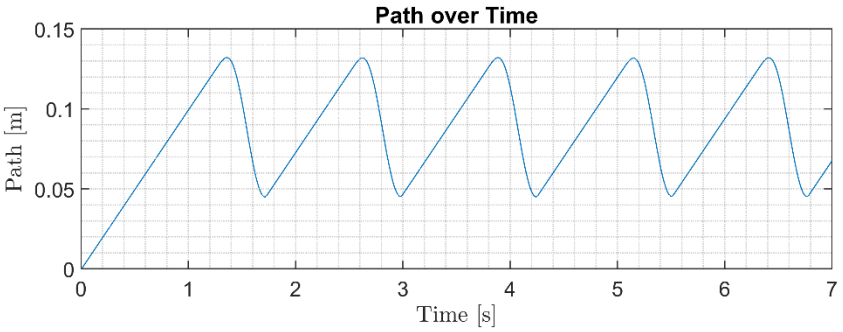
2. Computational Solution | Figure

Extract from the m-File:









3. Task list

- Create a Simulink model with the name "*P04_S_Stick_Slip_Effect_"+YourLastName+".slx*" with all necessary blocks and signals to achieve the presented results. The stop time should be changeable via the variable *tstop.*

- Create a m-File with the name "*P04_M_Stick_Slip_Effect_"+YourLastName+".m*". This file should contain:
  - An Init part
  - A part to load all necessary variables
  - A part to run or sim your Model
  - A part that saves your results of the path and the speed over the time in one plot with the name "*P04_Stick_Slip_Effect_Results_"+YourLastName+".png*". This should also implement a proper title, proper labels and of course the correct results (see p.12).
  - Use the Interpreter latex for *x*- and *ylabels*
  - Use the *print* command instead of *saveas* for saving as a .png with a resolution of 600 dpi

- Just send the .m and the .slx files to denis.zimmer@lba.hs-bremen.de

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Thank you for your Attention!

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