Sample projects for simulation with Jupyter Notebook

On this page

- The Bouncing Ball sample
- The Coffee Machine sample
- Spacecraft Mass Rollup sample
- Car Braking Analysis sample

Once you set up Jupyter Notebook, you can open and test sample projects created for server-side simulation using Jupyter. This chapter briefly describes the sample projects and explains how to execute them.

To access the sample projects

1. Set up Jupyter Notebook if you have not already done so.
2. Extract the <*install_root*>*plugins**com.nomagic.magicdraw.simulation**pyST.zip* file. The sample projects are located in the *samples* directory.

The Bouncing Ball sample

The *Bouncing Ball* sample project demonstrates server-side simulation with FMU. In addition, you can draw a chart based on the CSV data after the model execution.

Prerequisites

Add the Bouncing Ball sample project to the Teamwork Cloud server.

To run the *Bouncing Ball* sample and draw a chart based on the CSV data

1. Run the *Bouncing Ball* project and get the CSV data.

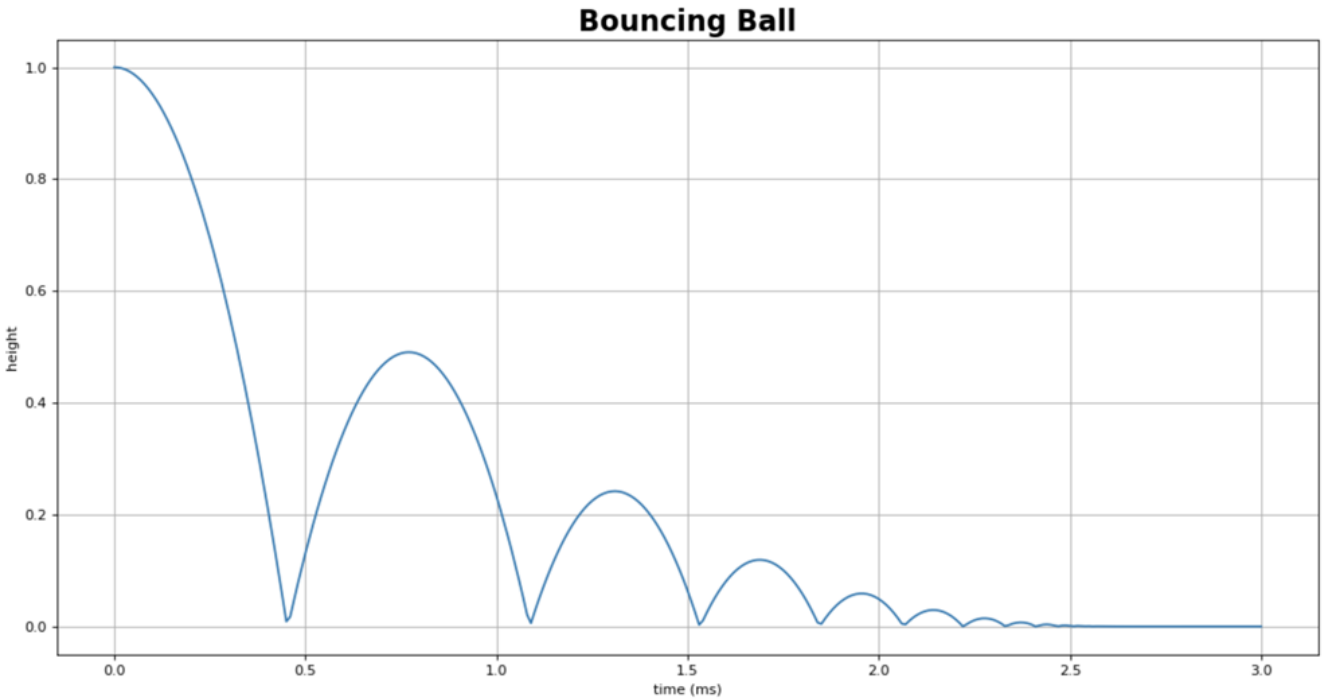
Request example for running the simulation

```
result = client.simulate('BouncingBall", config='Run BouncingBall')
csv = result['csvExports']['Bouncing Ball']
```

2. Draw a chart based on the CSV data.

Request example for drawing a chart based on the CSV data

```
import numpy as np
import matplotlib.pyplot import figure
from io import StringIO

figure(figsize=(16, 8), dpi=80
x = np.loadtxt(StringIO(csv), dtype='double', delimiter=',', skiprows = 1, usecols = (0)) / 1000
y = np.loadtxt(StringIO(csv), dtype='double', delimiter=',', skiprows = 1, usecols = (1))
plt.xlabel('time (ms)')
plt.ylabel('height')
plt.title('Bouncing Ball', fontweight="bold", fontsize=20)
plt.plot(x, y,)
plt.grid()
plt.show()
```



The *Bouncing Ball* chart drawn on the CSV data.

The Coffee Machine sample

The *Coffee Machine* sample project demonstrates server-side simulation with a specified HTML UI mockup. With this project, you can open the HTML UI window during model execution.

Prerequisites

- Add the *Coffee Machine* sample project to the Teamwork Cloud server.
- To open the HTML UI during server-side simulation, attach the HTML UI to the server project and commit the changes to the server.

To run the *Coffee Machine* sample and open the HTML UI window

1. Run the *Coffee Machine* project.

Request example for running the simulation

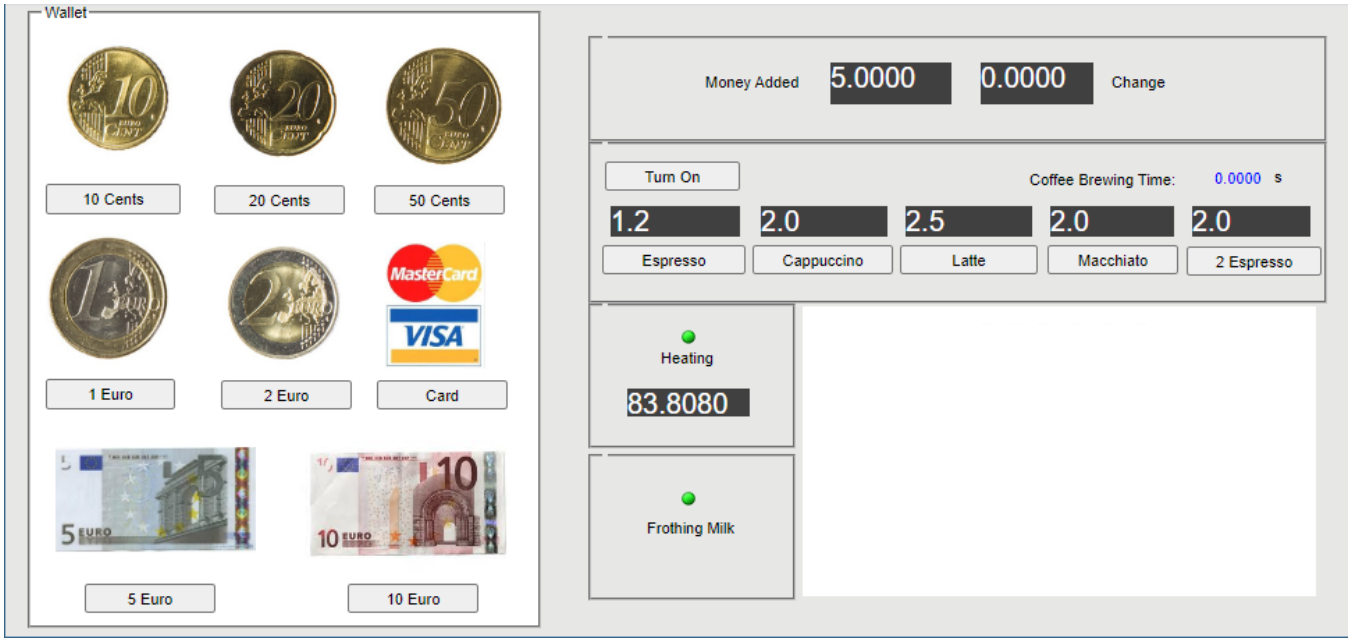
```
client.run('CoffeeMachine', config='Coffee Machine Web')

{'state': 'INITIALIZING',
 'simulationId': '20a84d37-0aba-4e12-9f14-ca381a5952f4',
 'project': 'CoffeeMachine',
 'elapsedTime': 106}
```

2. Check the simulation status.

Request example for getting the simulation status

```
client.get_status('20a84d37-0aba-4e12-9f14-ca381a5952f4')

{'state': 'RUNNING',
 'simulationId': '20a84d37-0aba-4e12-9f14-ca381a5952f4',
 'simulationTime': '0 ms',
 'ui': ['<server_address>/simulation/api/ui/20a84d37-0aba-4e12-9f14-ca381a5952f4/CoffeeMachine.html'],
 'project': 'CoffeeMachine',
 'config': 'Coffee Machine Web',
 'elapsedTime': 72742}
```

3. Click the UI URL in the response to the status request to open the HTML UI window.



The HTML UI window opened during the *Coffee Machine* project execution.

Spacecraft Mass Rollup sample

The *Spacecraft Mass Rollup* sample demonstrates server-side simulation with specified input and output parameters.

Prerequisites

Add the Spacecraft Mass Rollup sample project to the Teamwork Cloud server.

To run the *Spacecraft Mass Rollup* sample with input and output parameters

1. Do one or both of the following:
   - Specify a set of input parameters with values to be provided for the simulation.
   - Specify a set of output parameters to be obtained after the simulation is complete. If no output parameters are specified, all initialized values are returned.

Request example for running the simulation with input and output parameters

```
parameters = {
 "inputs":
   {
        "propulsion.thruster.me":32
        "telecom.amplifier.me":15
   },
 "outputs":
    [
        "me",
        "propulsion.me",
        "propulsion.tank.me",
        "propulsion.thruster.me",
        "telecom.me",
        "telecom.antenna.me",
        "telecom.amplifier.me"
    ]
}

client.run('SpacecraftMassRollup', config='spacecraft mass analysis', data=json.dumps
(parameters))

{'state': 'INITIALIZING',
 'simulationId': 'fc5fa7eb-761a-4d31-9201-2f51f1754675',
 'project': 'SpacecraftMassRollup',
 'elapsedTime': 187}
```

2. Get the simulation results.

Request example for getting simulation results

```
client.get_result('fc5fa7eb-761a-4d31-9201-2f51f1754675')

{'outputs': {'me': 104.0,
  'telecom.me': 34.0,
  'telecom.amplifier.me': 15.0,
  'telecom.antenna.me': 19.0,
  'propulsion.me': 70.0,
  'propulsion.tank.me': 38.0
  'propulsion.thruster.me': 32.0},
 'verification': [{'property': 'propulsion.thruster.me',
   'status': 'fail',
   'value': 32.0,
   'requirements': [{'id': '1',
     'text': 'Estimated mass shall be less than allocated mass',
     'status': 'fail',
     'timestamp': 0}],
   'constraints': [{'constraint': 'me < ma',
     'status': 'fail',
     'timestamp': 0}]},
  {'property': 'telecom.amplifier.me',
   'status': 'fail',
   'value': 15.0,
   'requirements': [{'id': '1',
     'text': 'Estimated mass shall be less than allocated mass',
     'status': 'fail',
     'timestamp': 0}],
   'constraints': [{'constraint': 'me < ma',
     'status': 'fail',
     'timestamp': 0}]}]}
```

Car Braking Analysis sample

The *Car Braking Analysis* sample project demonstrates the server-side simulation that calculates the stopping distance. You can use this project for the following scenarios:

- Running the project to see the relationship between the vehicle mass and braking distance.
- Running the project to calculate the stopping distance according to the car mass and speed.

> **Prerequisites**
>
> Add the *Car Braking Analysis* sample project to the Teamwork Cloud server.

To run the *Car Braking Analysis* sample to see the relationship between the vehicle mass and braking distance

---

1. Run the *Car Braking Analysis* project while changing the mass of the car, e.g., by 20 kg.

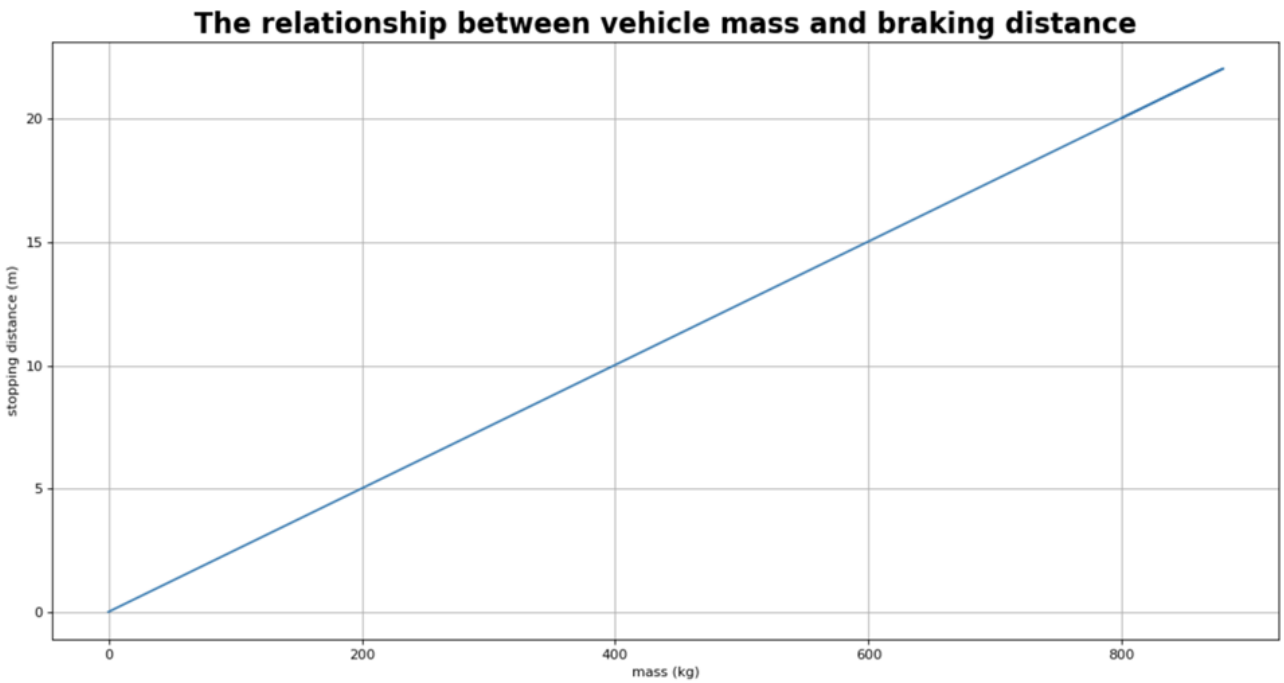
   Request example for running the simulation with a changed mass

   ```
   mass = [0] * 10
   distance = [0] * 10
   for x in range(0, 5):
       mass[x] = 800 + 20 * x
       parameters = {
         "inputs":
         {
           "grossMass": mass[x]
         }
       }
       results = client.simulate('CarBrakingAnalysis_final', config='Vehicle Analysis no Matlab',
   commit_results=False, data=json.dumps(parameters))
       distance[x] = results['outputs']['stoppingDistance']
       print(mass[x], distance[x] )
   ```

2. Draw the chart of the relationship between the vehicle mass and braking distance.

   Request example for drawing the chart

   ```
   import numpty as np
   import matplotlib.pyplot as plt
   from matplotlib.pyplot import figure
   from io import StringIO

   figure(figsize=(16, 8), dpi=80)
   plt.xlabel('mass (kg)')
   plt.ylabel('stopping distance (m)')
   plt.title('The relationship between vehicle mass and braking distance', fontweight="bold",
   fontsize=20)
   plt.plot(mass, distance)
   plt.grid()
   plt.show()
   ```



The chart showing the relationship between the vehicle mass and stopping distance.

To run the *Car Braking Analysis* sample to calculate the stopping distance

---

1. Run the *Car Braking Analysis* sample to calculate the stopping distance according to the specified car mass and speed.

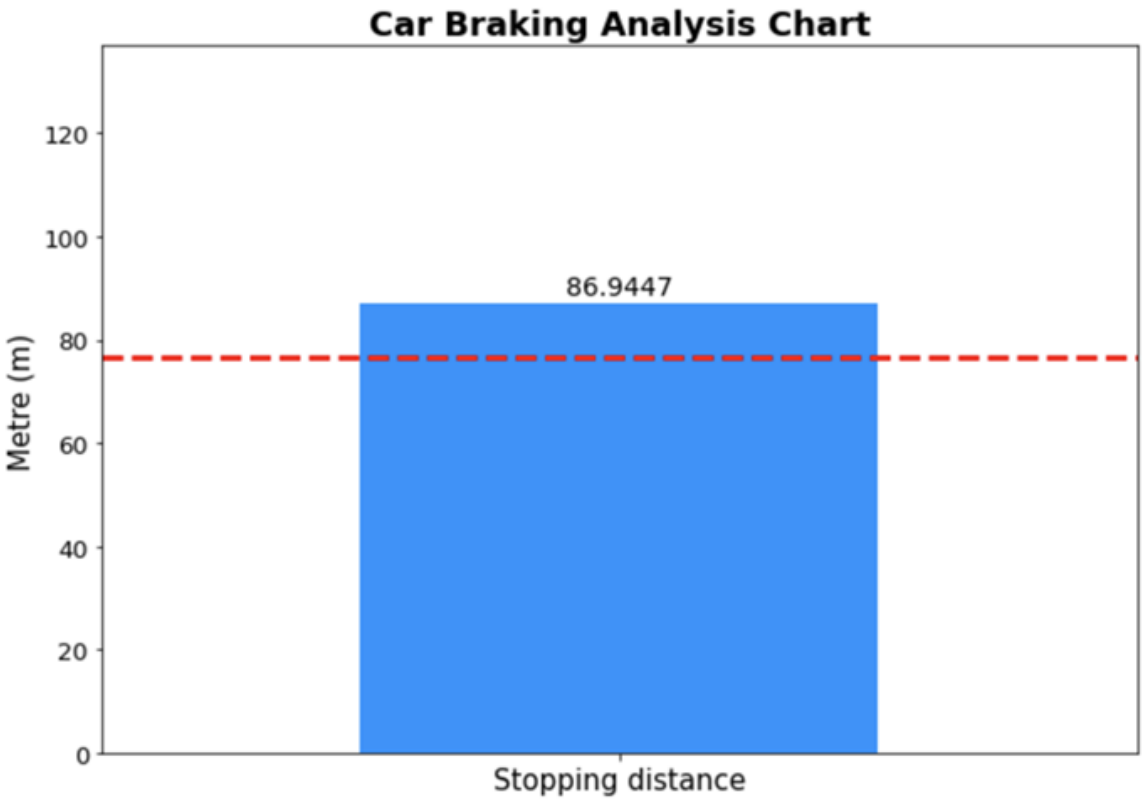
Request example for running the simulation to calculate the stopping distance

```
speed = input("Enter the car speed (km/h):")
totalMass = input("Enter the car mass (kg):")

parameters = {
  "inputs":
  {
    "grossMass": totalMass,
    "speed": speed
  }
}

results = client.simulate('CarBakingAnalysis', config='Vehicle Analysis no Matlab', data=json.dumps
(parameters))
distance = results['outputs']["stoppingDistance"]
requiredDistance = results['outputs']["requiredStoppingDistance"]
print("Stopping distance:", distance)
print("Failed requirements:")
print(json.dumps(results['verification'], indent=2))
```

2. Draw a chart to show the car stopping distance with the threshold of the required maximum stopping distance.

Request example for drawing the chart

```
import matplotlib.pyplot as plt
import matplotlib as mpl
import numpy as np
import pandas as pd

data = pd.DataFrame(
    {"distance": [distance]})
ax = data.plot(kind='bar'
               figsize=(10,7), color=['dodgerblue'], fontsize=13);
plt.axhline(y=requiredDistance, linewidth=3, linestyle='--', color='r')
ax.set_ylim([0, distance+50])
plt.title("car Braking Analysis Chart", fontsize=18, weight="bold")
plt.ylabel("Metre (m)", fontsize=15)
plt.text(0, distance+2, round(distance, 4), ha = 'center', fontsize=14)
ax.get_legend().remove()
plt.xticks(np.arange(1), ["Stopping distance"], rotation="horizontal", fontsize=15);
```



The chart showing the car stopping distance with the threshold of the required maximum stopping distance.