ANSYS®

Parametric simulation of the pipe flow in ANSYS CFX

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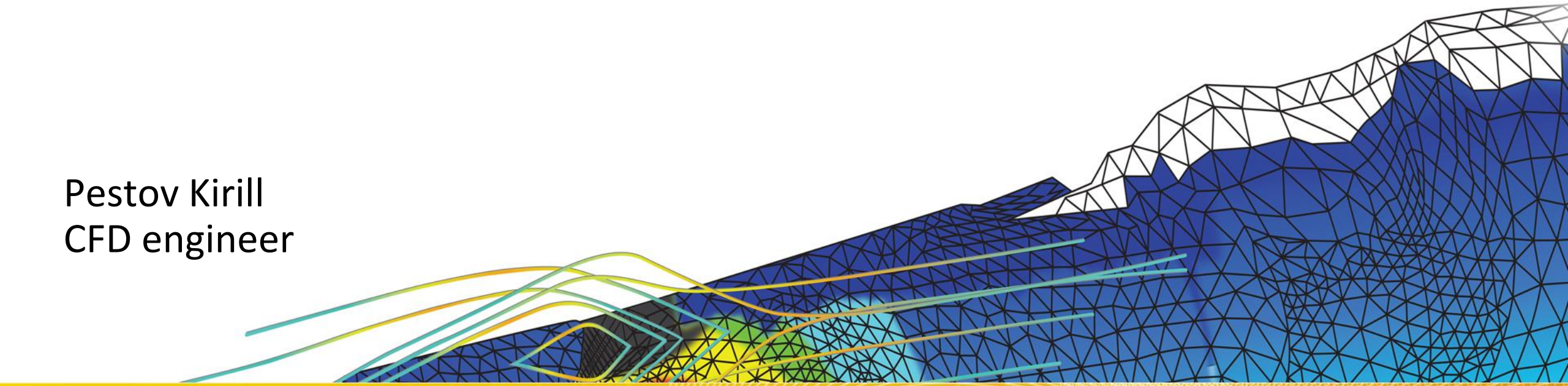
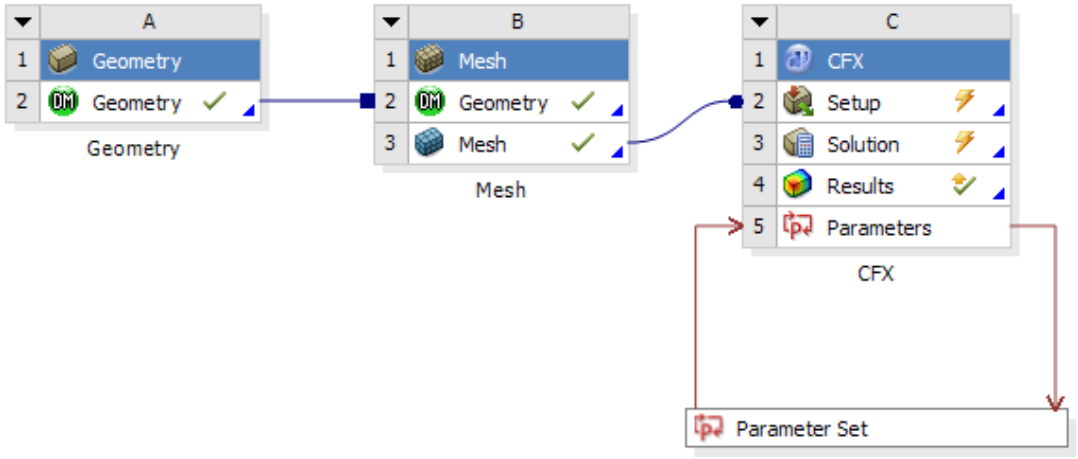


Workbench project

- **Parametric model for pipe in ANSYS Workbench is shown in the picture.**
- **Input parameters:**
  - **Inlet pressure (PT0)**
  - **Outlet pressure (P0)**
- **Output parameter:**
  - **Mass flow rate (MassFlow)**
- **Working fluid, models, boundary conditions and initial conditions are set according to the test case description.**



Workbench project schematic

Table of Design Points

	A	B	C	D	E	F	G
1	Name	P1 - PT0	P2 - P0	P3 - MassFlow	Retain	Retained Data	Note
2	Units	atm	atm	kg s^-1			
3	DP 0 (Current)	0	0	15130	☑		
*					☐		

Workbench parameters

Python script

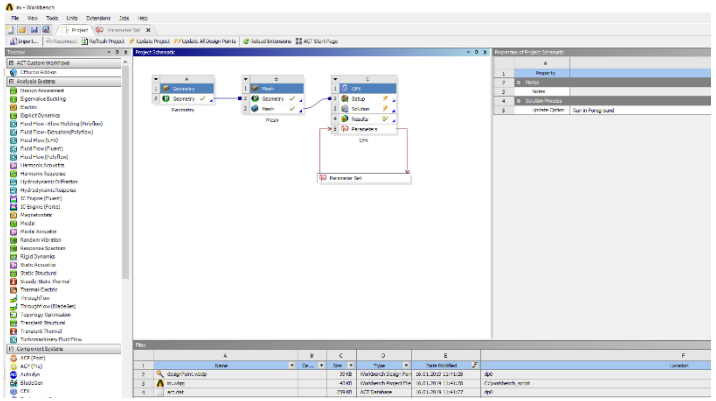
- **Python script: script.wbjn**
  - **General script workflow:**
    - **Part 1: declare design point (DP) and parameters.**
    - **Part 2: read values of the pressure from input.txt.**
    - **Part 3: insert pressure values into Workbench parameters.**
    - **Part 4: update project.**
    - **Part 5: write mass flow in output.txt.**
- **No new DP is created. Values for the first DP are constantly overwritten.**

```
dp_1 = Parameters.GetDesignPoint(Name="0")
pt0 = Parameters.GetParameter("P1")
p0 = Parameters.GetParameter("P2")
mass_flow = Parameters.GetParameter("P3")


def get_pressure(input_file_path):
    if os.path.exists(input_file_path):
        print('Open input file')
        with open(input_file_path) as input_file:
            for line in input_file:
                yield line
    else:
        print('ERROR: {} does not exist'.format(input_file_path))
        sys.exit(0)


def insert_parameters(output_file_path):
    for line in get_pressure(input_file_path):
        pressure_in, pressure_out = line.split()[0], line.split()[1]

        print('Insert pressure values')
        print('Inlet pressure: {} [atm], Outlet pressure: {} [atm]'.format(pressure_in, pressure_out))
        dp_1.SetParameterExpression(Parameter=pt0, Expression="{} [atm]".format(pressure_in))
        dp_1.SetParameterExpression(Parameter=p0, Expression="{} [atm]".format(pressure_out))

        print('Updating parameters')
        Update()

        if os.path.exists(output_file_path):
            with open(output_file_path, 'aw') as output_file:
```

Main Python script

Files and Workflow

Necessary files for run



ini.wbpz

Workbench archive

```
dp_1 = Parameters.GetDesignPoint(Name="0")
pt0 = Parameters.GetParameter("P1")
p0 = Parameters.GetParameter("P2")
mass_flow = Parameters.GetParameter("P3")


def get_pressure(input_file_path):
    if os.path.exists(input_file_path):
        print('Open input file')
        with open(input_file_path) as input_file:
            for line in input_file:
                yield line
    else:
        print('ERROR: {} does not exist'.format(input_file_path))
        sys.exit(0)


def insert_parameters(output_file_path):
    for line in get_pressure(input_file_path):
        pressure_in, pressure_out = line.split()[0], line.split()[1]

        print('Insert pressure values')
        print('Inlet pressure: {} [atm], Outlet pressure: {} [atm]'.format(pressure_in, pressure_out))
        dp_1.SetParameterExpression(Parameter=pt0, Expression="{} [atm]".format(pressure_in))
        dp_1.SetParameterExpression(Parameter=p0, Expression="{} [atm]".format(pressure_out))

        print('Updating parameters')
        Update()

        if os.path.exists(output_file_path):
            with open(output_file_path, 'aw') as output_file:
```

script.wbjn

Main Python script

```
1.575 1.5
1.76 1.6
2.21 1.7
2.52 1.8
3.0 2.0
```

input.txt

output.txt

Input and Output files

```
import sys


wb_path = r'"C:\Program Files\ANSYS Inc\v192\Framework\bin\Win64\runwb2"'
script = 'script.wbjn'
cmdline = '{} -B -R {}'.format(wb_path, script)

try:
    os.system(cmdline)
except Exception:
    print('Failed to launch ANSYS Workbench!')
    sys.exit(0)
```

run.py

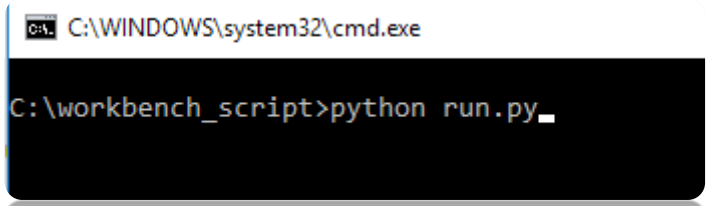
run.py for launching main python script script.wbjn

The five files should be in the same directory

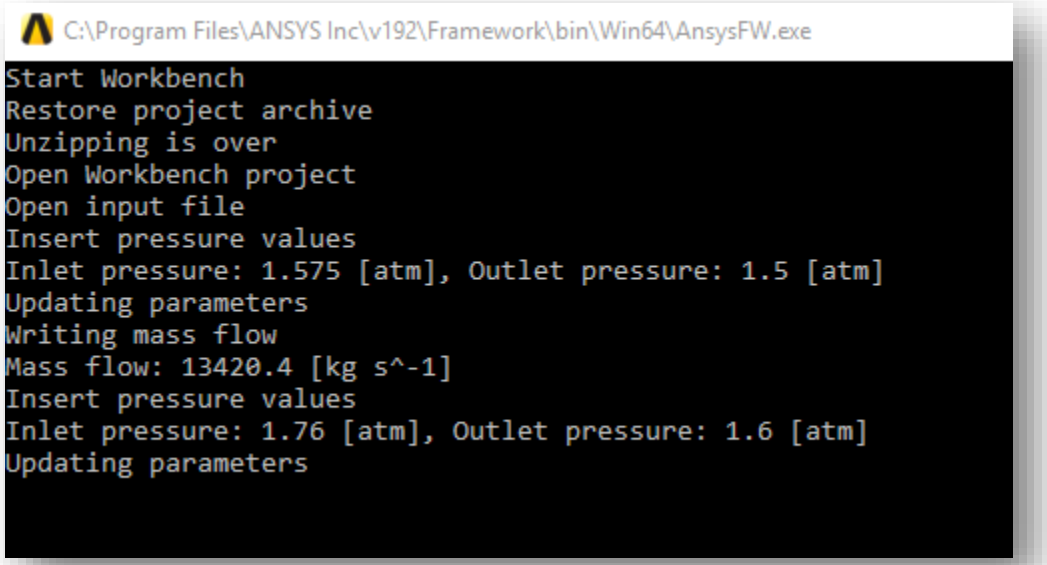
Files and Workflow

Limitation: work only with ANSYS Workbench v19.2!*

- Place the Python scripts run.py and script.wbjn in the same folder as the Workbench Project and input.txt, output.txt files.
- Save and archive Workbench project.
- Close Workbench Project.
- Delete *.wbpj and Workbench project dir *_files and remain only Workbench archive *.wbpz.
- Run Windows terminal:
  - Navigate to the working directory where the source files are stored.
  - At the command prompt type: python run.py.
  - Python Script is launched and parametric study starts.
- In the new opened Workbench terminal window it is possible to track the process of parametric study.
- New Workbench project will be created with a name test.wbpj
- Mass flow values will be written in the output.txt file.



Windows command line



Workbench terminal window

*If you want to run script in another version, please change the following lines:

In script.wbjn:

```
SetScriptVersion(Version="19.2.120")
```

In run.py:

```
wb_path = r'"C:\Program Files\ANSYS Inc\v192\Framework\bin\Win64\runwb2"'
```

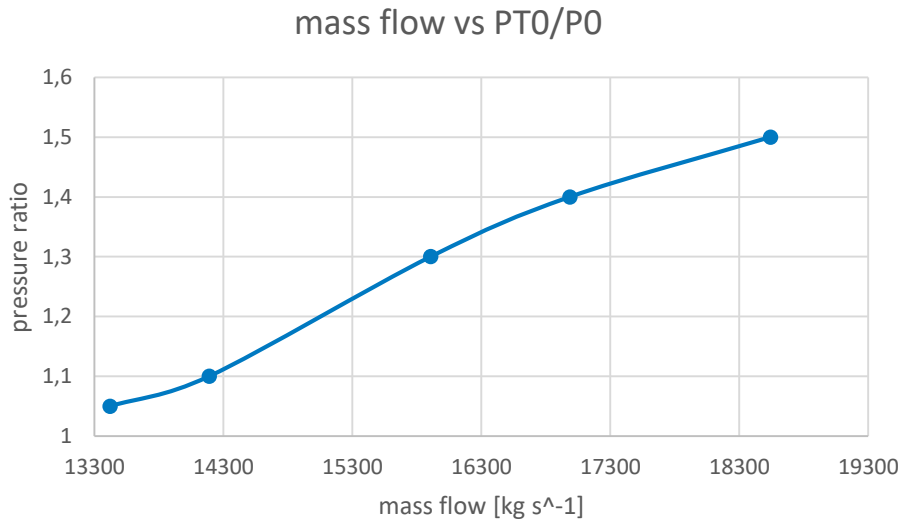
Results

- **After processing the script, we get the output file with mass flow values.**

```
1  13420.4
2  14189.3
3  15906.7
4  16986.3
5  18541.3
6
```

output.txt

PT0/P0	mass flow [kg s^-1]
1,05	13420,4
1,1	14189,3
1,3	15906,7
1,4	16986,3
1,5	18541,3



Dependency between the mass flow and pressure ratio (PT0/P0)