

# AI-SURSPEED

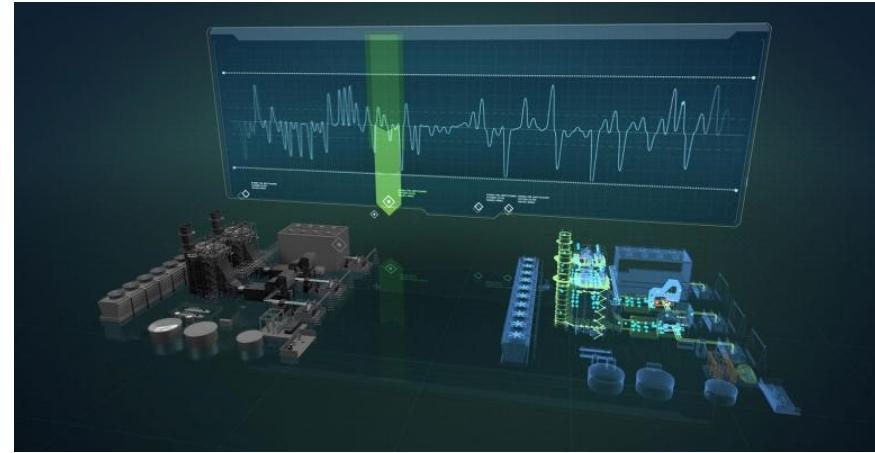
## AI for faster process simulation

THTH autumn seminar  
Industrial AI workshop, 29.10.2019  
Mikko Tahkola

25/10/2019 VTT – beyond the obvious

# The challenge in system simulation

- System simulation is used as a tool in multiple applications such as
  - System design, optimisation, operator training.
- The challenge - complex simulation models are often slow to run and this limits their usability.
- AI to accelerate simulation speed to address this challenge?

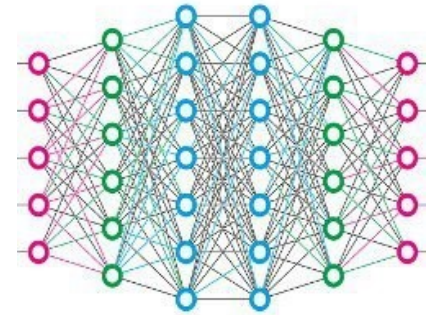


Material Handling & Logistics, 2019. Digital twins can be leveraged as management tool.  
<https://www.mhlnews.com/technology-automation/digital-twins-can-be-leveraged-management-tool>

# AI-SURSPEED

## Overview of the solution

- Applying AI methods in building a surrogate, or a substitute, model of the original model.
- The aim is to make the method as automated as possible
- Combining system modelling and simulation, data and artificial intelligence
  - Aiming to improve the overall efficiency of the engineering design of complex systems
- The solution is not limited to a specific simulation software.



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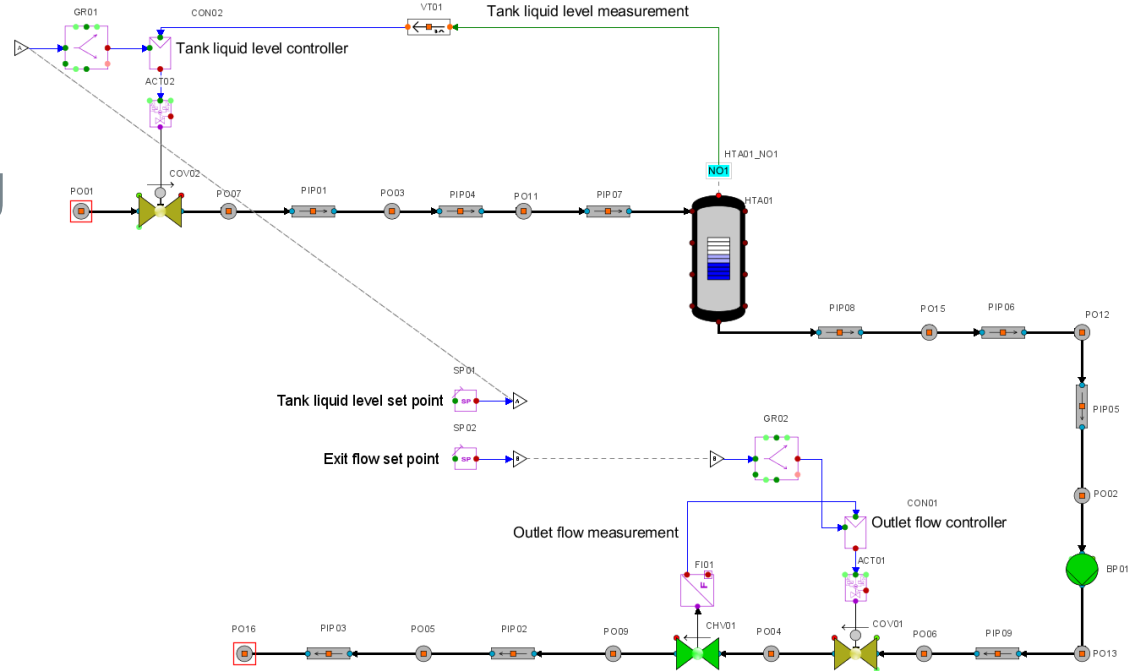
# Initial results

## Case 1: Controlled water tank process

- We used Apros® to build a model and generate data for machine learning

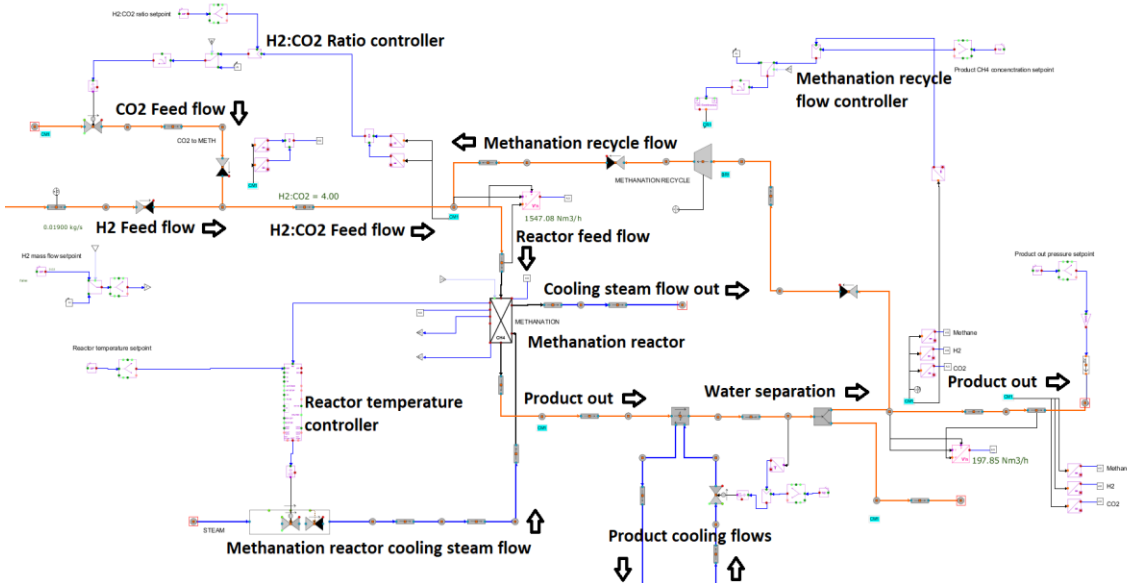
- The machine learning surrogate:

- Had almost zero error compared to the original.
- Handled unseen situations well
- Was faster to run



# Initial results

## Case 2: Methanation reactor in power-to-gas process



- Much more complex dynamics.
- On average, the prediction error was ~3 % compared to the original model.
- Speed (x real-time)
  - AproS: 50 X real-time
  - ML surrogate: 15 000 x real-time
  - 300 times faster than AproS.

Prediction time [ms]

Model type	Training	Validation	Testing
ARX	0,23	0,20	0,22
NARX	0,27	0,28	0,29
LSTM	0,43	0,44	0,41
GRU	0,40	0,41	0,39

# Potential benefits of speeding up simulation

- A single model with high accuracy can be used in wide range of applications
  - No need to build separate models for each
- Faster simulation speeds up engineering and R&D work as simulation results are produced faster



# bey<sup>0</sup>nd

## the obvious

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