Machine Learning for Enhancing Geothermal Energy

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Real-time simulation of geochemical processes in geothermal power plants

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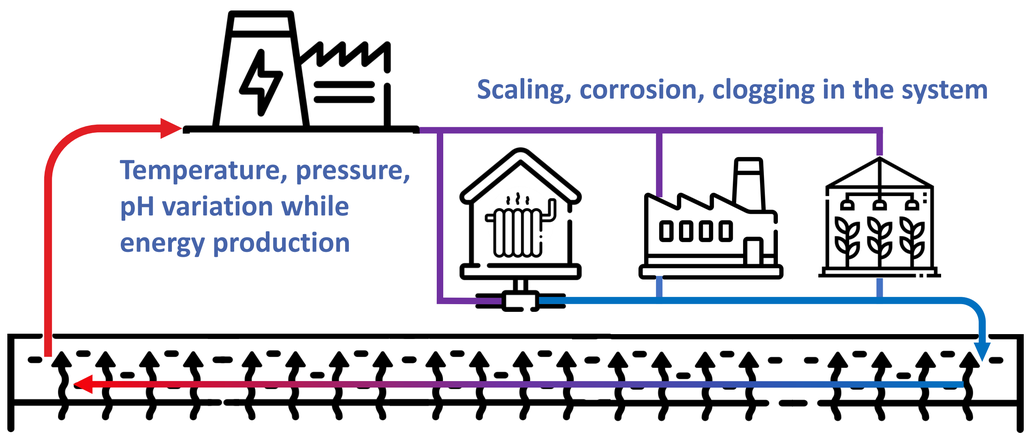
Motivation

Using artificial intelligence (AI) to increase the efficiency of geothermal power plants. This AI is trained using real-time geochemical modelling of the thermal water cycle via cyber-physical twin and processes simulations.

Issue

Mimicking and modelling the hydrogeochemical processes of the power plant's thermal water cycle. Parameter variation leads to perturbation of the chemical equilibrium, which is predicted by a digital twin.

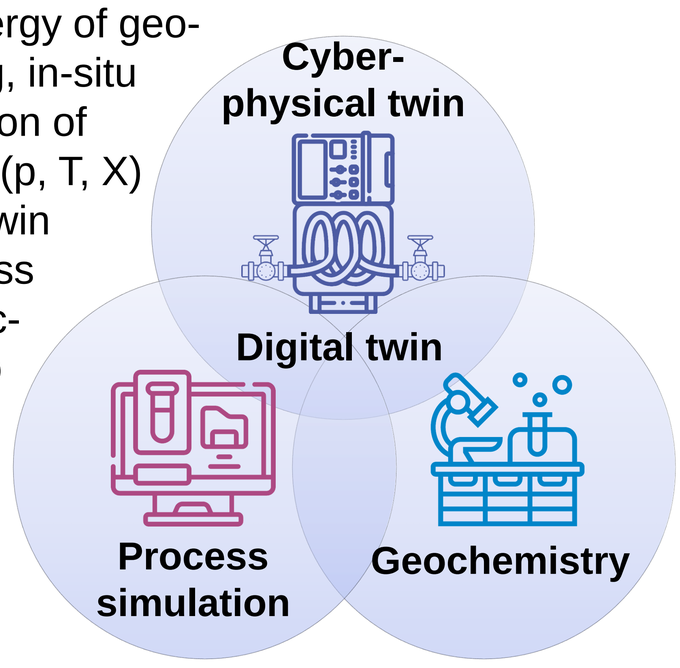
Parameter variation through power plant & thermal water cycle



Synergy of the digital twin

Predicting scaling, degassing and corrosion at the power plant using the synergy of geo-chemical monitoring, in-situ experimental variation of system parameters (p, T, X) via cyber-physical twin and real-time process simulation of produc-tion parameters into a digital twin.

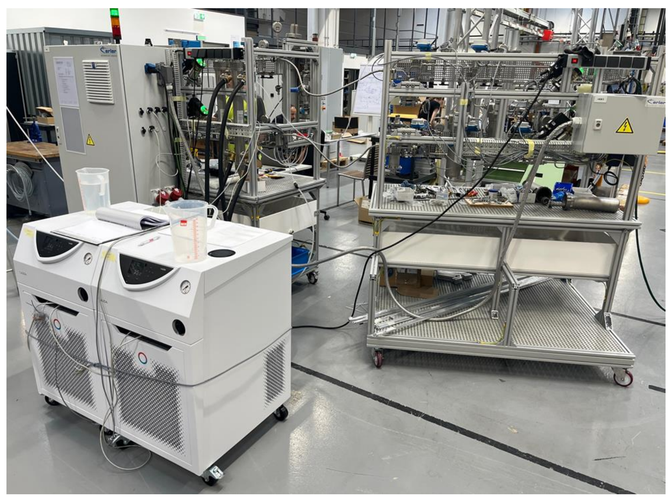
Interoperation of process simulation, geochemistry, and cyber-physical twin



Cyber-physical twin

Connecting the demonstrator via bypass to the production site of the power plant and perform, sample, and monitor in-situ experiments of system parameter variation.

Demonstrator connected to geothermal power plant via bypass



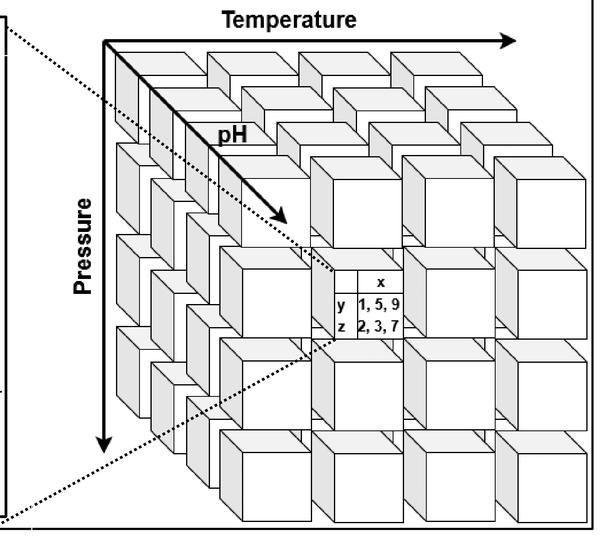
Process simulation

Systematic monitoring of power plant parameters (p, T, pH, redox, flow rate) throughout the thermal water cycle. Real-time simulation of hydrogeochemical processes.

Computation of aqueous species of the fluid at real-time

Aqueous species

H^+	HCO_3^-	Cl^-
OH^-	$CaHCO_3^+$	$FeCl^+$
H_2O	CO_2	$FeCl^{+2}$
	$NaHCO_3$	$FeCl_2^+$
$Al(OH)_4^-$	$MgHCO_3^+$	$FeCl_3$
$Al(OH)_2^+$	$FeHCO_3^+$	
$AlOH^{+2}$	$CaCO_3$	Fe^{+2}
$Al(OH)_3$	$NaCO_3^-$	$FeCl^+$
Al^{+3}	CO_3^{-2}	$FeHCO_3^+$
$AlSO_4^+$	$BaHCO_3^+$	$FeSO_4$
$Al(SO4)_2^-$	$FeCO_3$	$FeOH^+$



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