# Smoothing of well rates
# in subsurface hydrocarbon reservoir simulators

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## Background

We are a start-up company which targets the hydrocarbon reservoir engineering community. We develop software tools for simulation of subsurface flows in deformable porous media. This is being done by modeling the physical problem by a system of partial differential equations. This system is discretized numerically and solved at a number of time steps. As a result of a simulation one has, as primary variable, the mechanical displacements and the fluid pressure resolved at any spatial location and time instance. A number of derived quantities, such as mechanical stresses, fluid velocity, etc are also computed. We are interested to relate such computations to localized processes which occur in particular locations in a subsurface reservoir.

## The problem

A common problem in reservoir simulators is the history matching problem, where a number of wells are operated at a prescribed flow rate, measured by the operator. The data provides input to a simulator which then has to match various other measured quantities, such as pressure drop at wells, movement of saturation fronts, water break-out and other.

History matching computations are done multiple times until rock parameters are modified to achieve a satisfactory match. This requires a fast simulator. A common problem is that the input data is very rough and if input directly would cause considerable numerical difficulties, such as excessive Newton iterations to converge or excessively small time-steps.

A typical input for a well is a flow rate, specified at discrete time instances, which is positive at every instance. The goal is to replace the “rough” flow rate with a smoother function, which retains two properties of the original:

1. It remains positive at very instance;

2. The integral over the entire time range, i.e. the total liquid produced is preserved.

ppResearch will provide participants with typical datasets and would like to see different smoothing scenarios, using some characteristic time-scale which fulfill the above two properties.