INSTITUTE OF VISUAL COMPUTING

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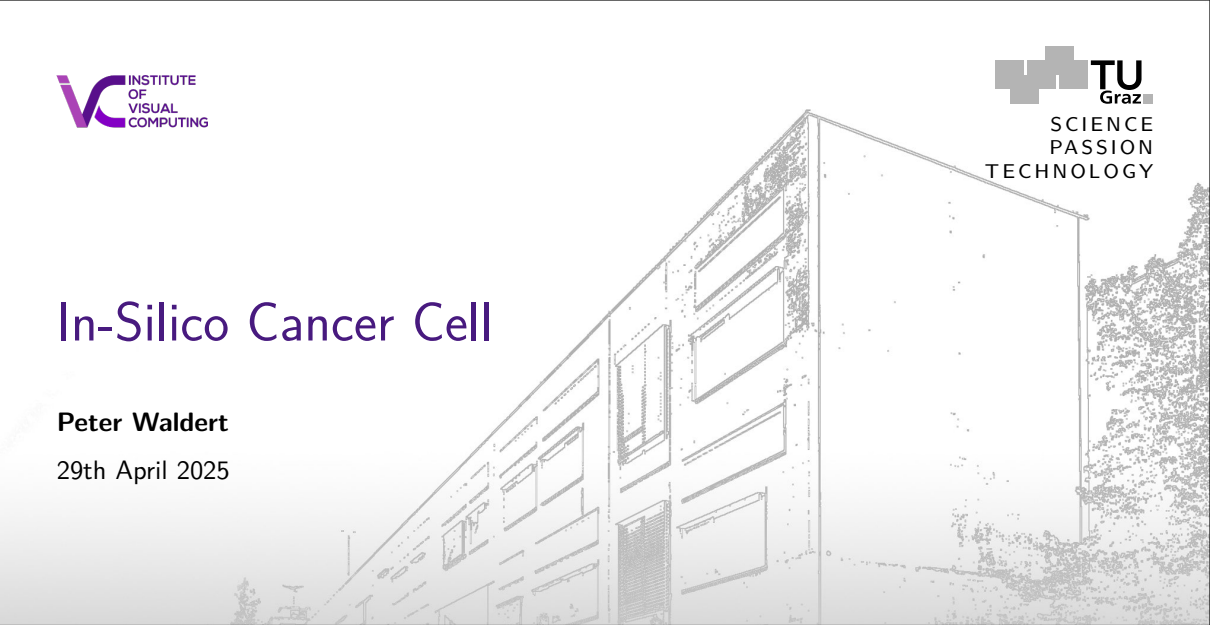
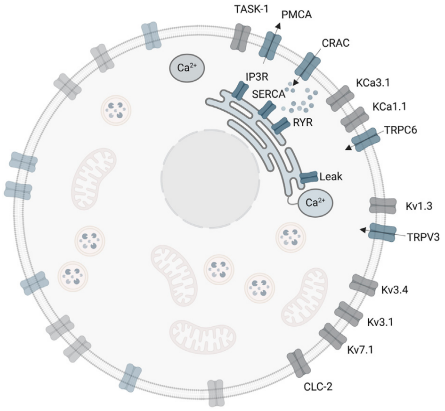


In-Silico Cancer Cell

Peter Waldert

29th April 2025

Biological Setting: Cancer Cell



Indeed

Experiment: Patch-Clamping

Figure: Patch-Clamp System [1]

Approach in which electrophysiological behaviour of a cell can be measured in a lab.

- Cell-attached recording method
- Whole-cell recording method

Simulation of the Experiment

Hidden Markov Model

The whole cell current $I : T \to \mathbb{R}$ over time $t \in T \subset \mathbb{R}^+$ is the sum of all individual channel contributions $I_k, k \in \{1, ..., M\}$ over $M \in \mathbb{N}$ channel types

$$I(t) := \sum_{k=1}^{M} N_k I_k(t) = \sum_{k=1}^{M} N_k g_k p_{o,k} \left(V(t) - E_k\right) .$$

At each time step, the next state $\boldsymbol{s}_{k,n+1} \in [0,1]^{N_{s,k}}$ of the k-th channel type is obtained by

$$\boldsymbol{s}_{k,n+1} = H_k \left(V(t_n), \boldsymbol{C}(t_n), t_n\right) \boldsymbol{s}_{k,n} , \quad \text{with} \quad t_n := \sum_{i=0}^{n} (\Delta t)_i .$$

Solution of the Inverse Problem

Runtime Optimisation

Visualisation Dashboard

WebAssembly

Cancer Cell Simulation

- Let's go!

References I

[1] **Patch-Clamp Electrophysiology.** Apr. 2025. URL: https://www.criver.com/products-services/discovery-services/pharmacology-studies/neuroscience-models-assays/neuroscience-methods-endpoints/electrophysiology/patch-clamp?region=3696 (visited on 29/04/2025).