UncertainPy: A Python toolbox for uncertainty quantification of computational neuroscience models

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Grunnlegende nevrovitenskap

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Usikkerhetsberegninger

Computational models are created from experimental data

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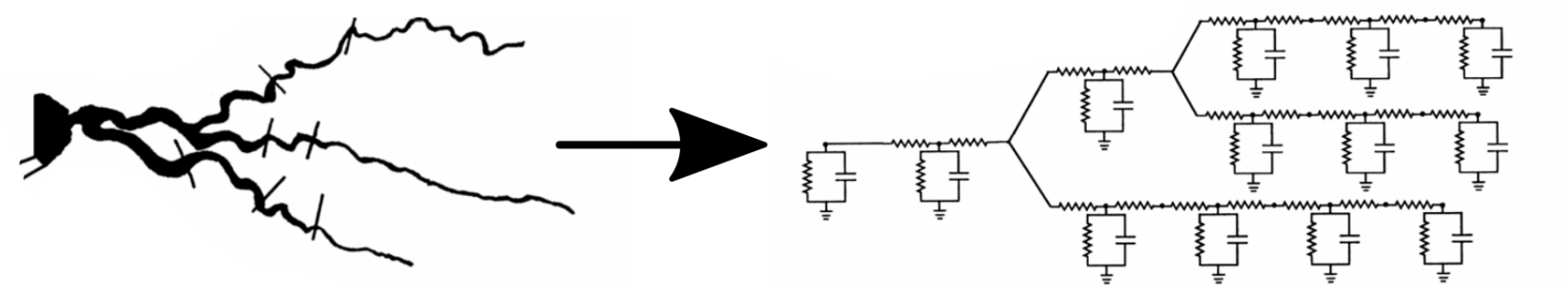

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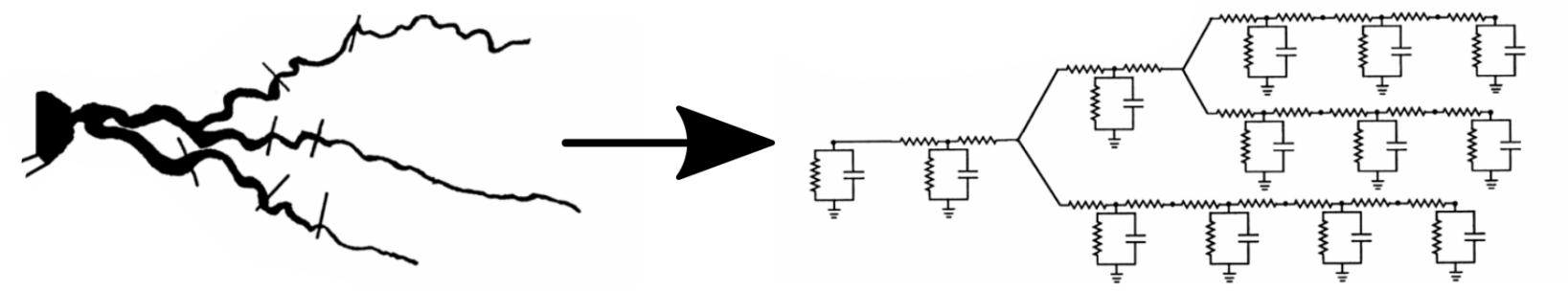
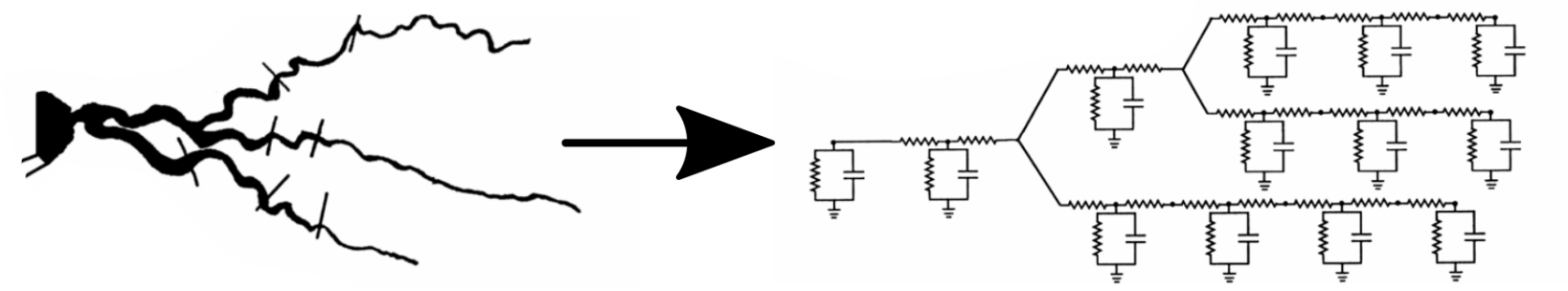


$$I = C_m \frac{\mathrm{d}V_m}{\mathrm{d}t} + I_K + I_{Na} + I_l$$

Computational models are created from experimental data



$$I = C_m \frac{\mathrm{d}V_m}{\mathrm{d}t} + \mathbf{I_K} + \mathbf{I_{Na}} + \mathbf{I_l}$$

Different parameters give different model results

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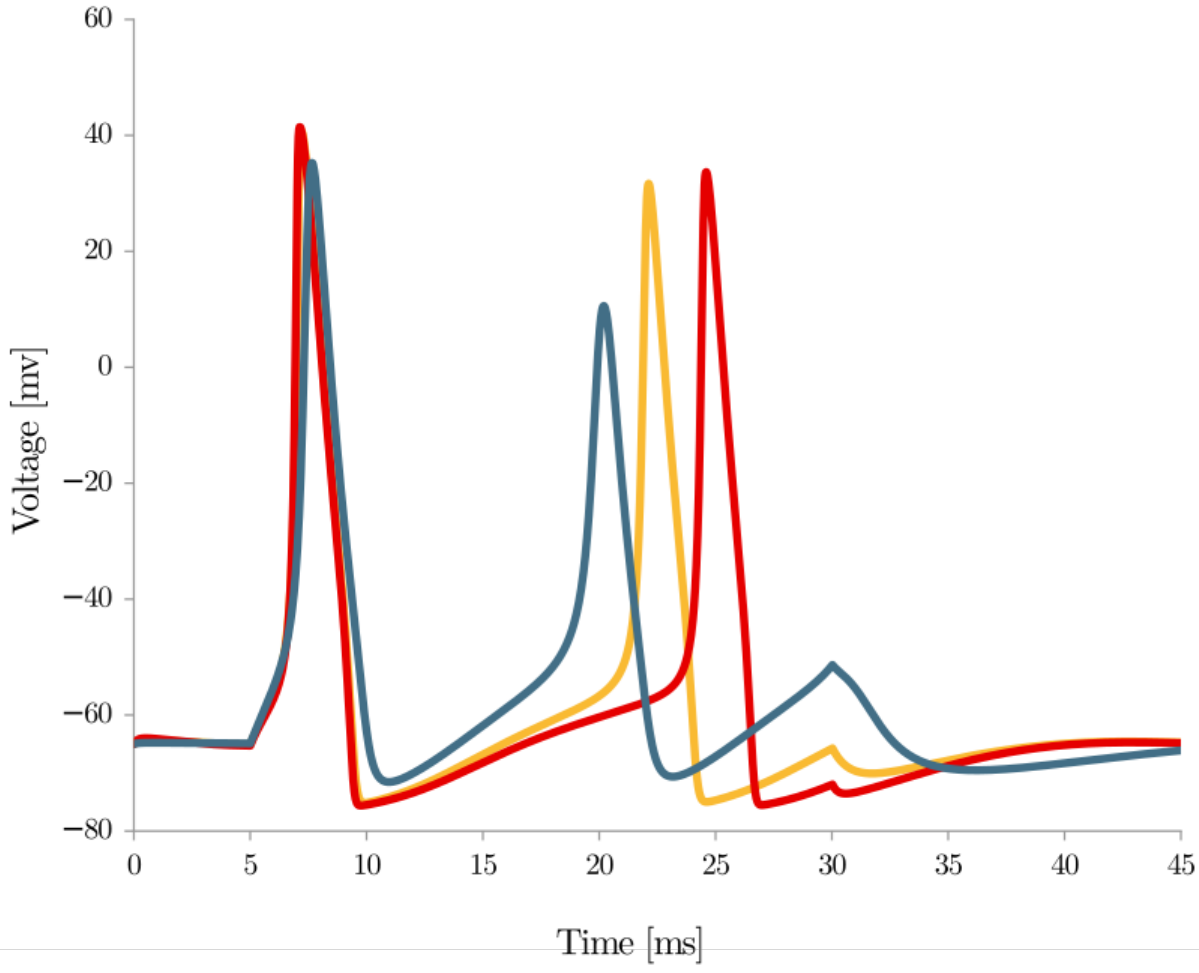
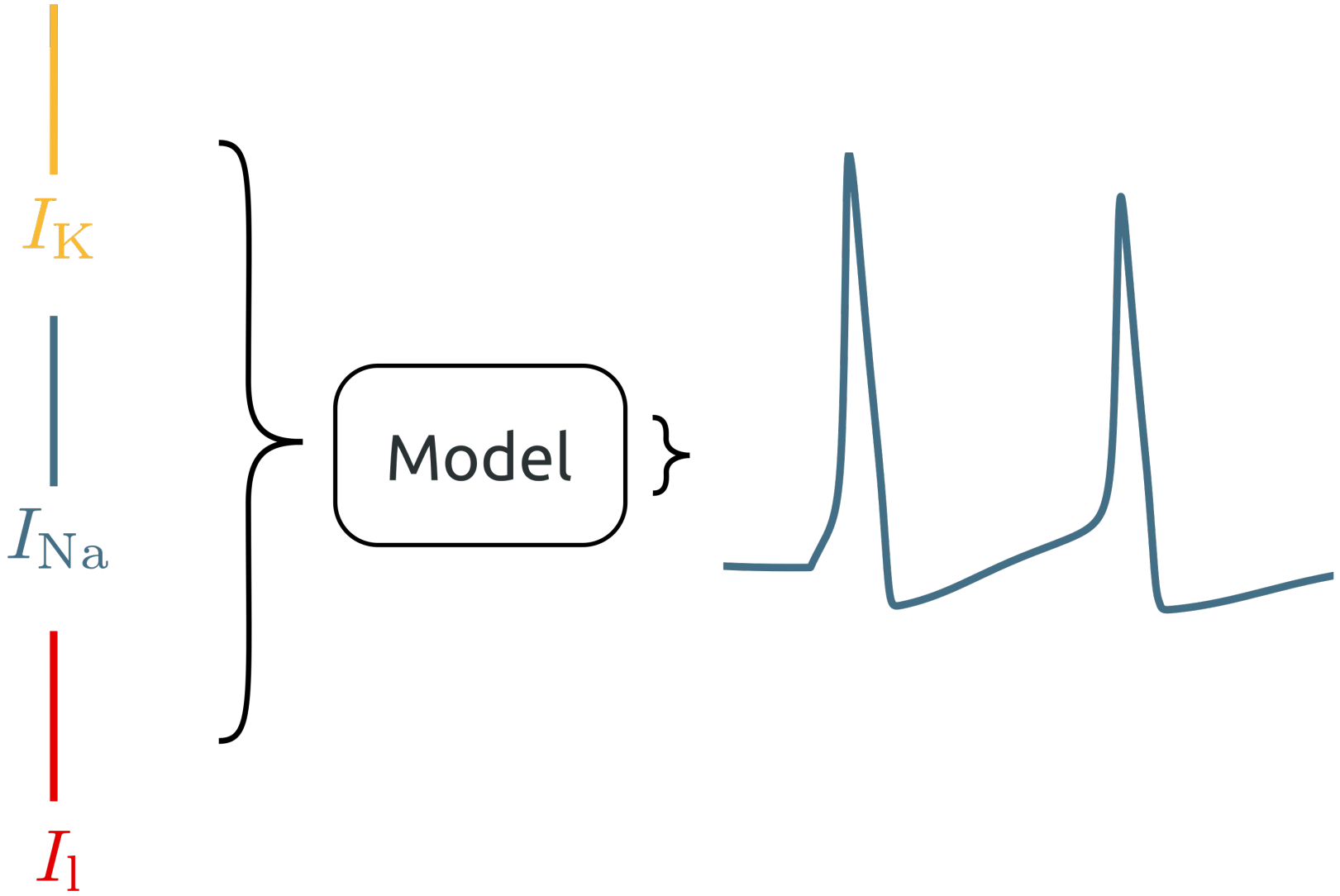
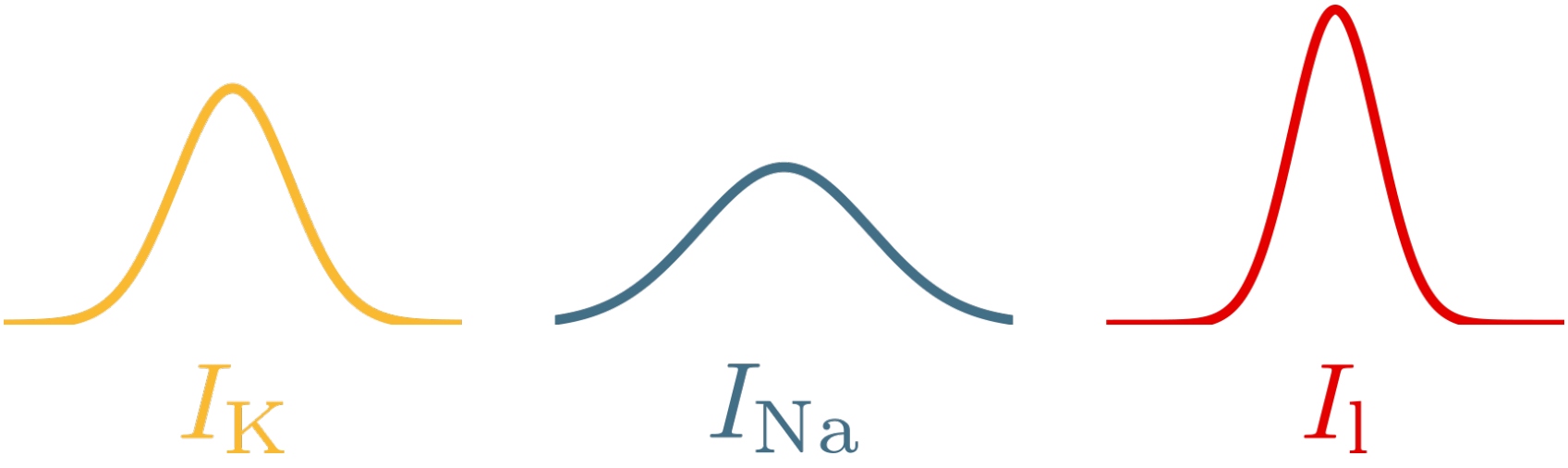


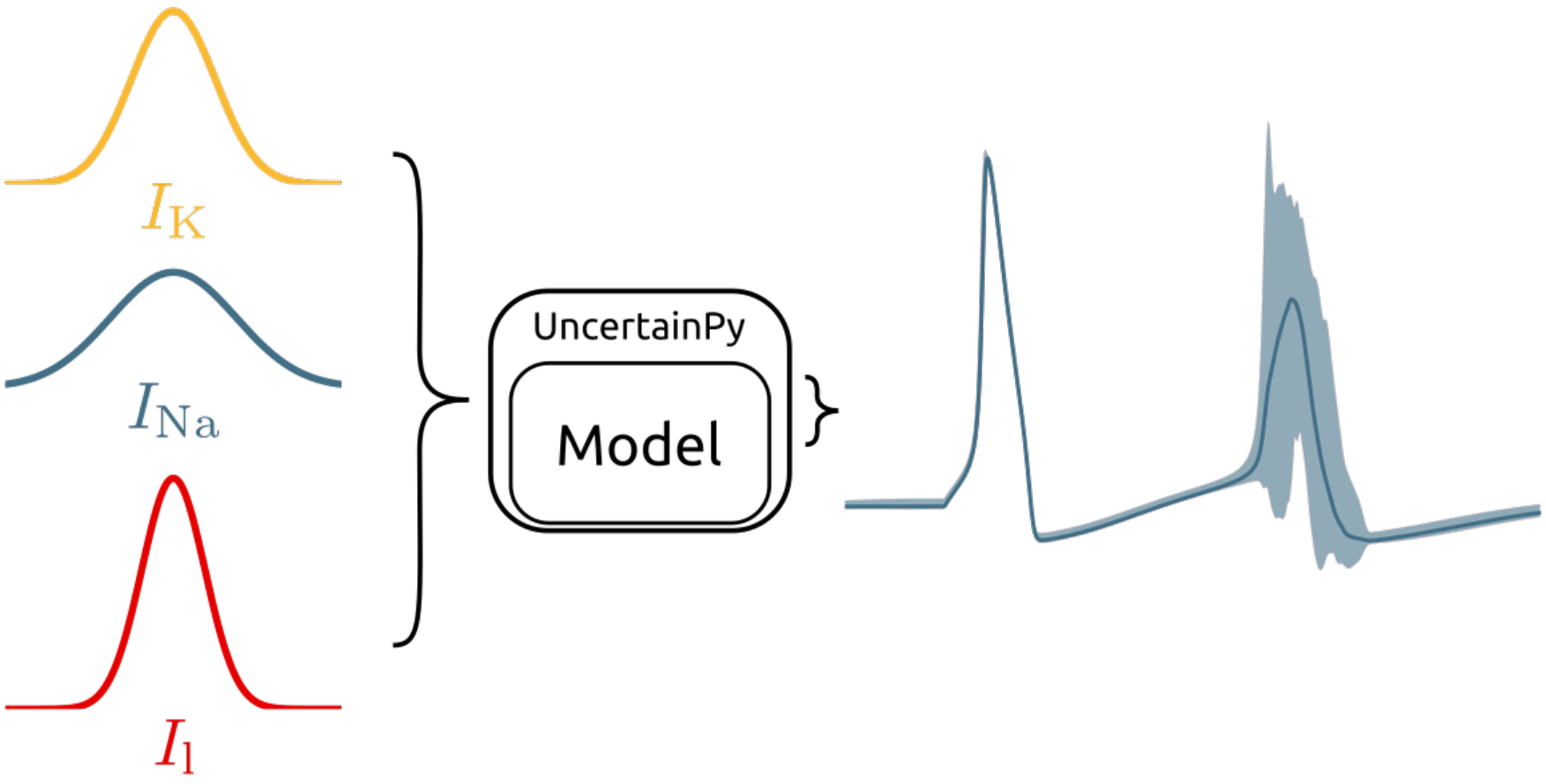
Traditional models are deterministic



Problem: Biological parameters are not fixed, but have inherent variability



Solution: Perform an uncertainty quantification, which relates uncertain input to uncertain output



Creating a computational model consists of three steps, model creation, parameter estimation and uncertainty quantification

$I = C_m \frac{\mathrm{d}V_m}{\mathrm{d}t} + I_{\text{ion channels}}$ **Model creation**

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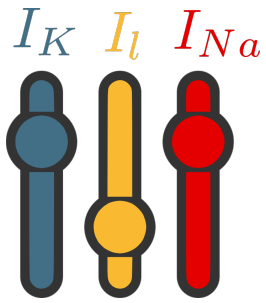
Model creation



Estimate parameters

Creating a computational model consists of three steps, model creation, parameter estimation and uncertainty quantification

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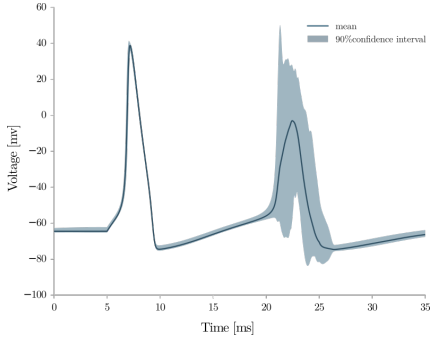
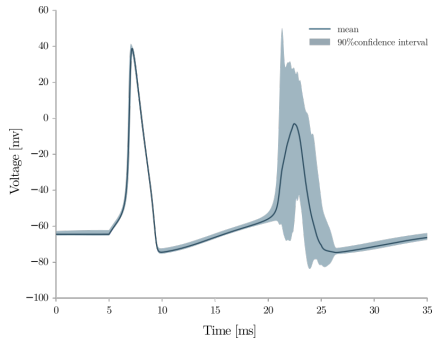
Model creation

Estimate parameters



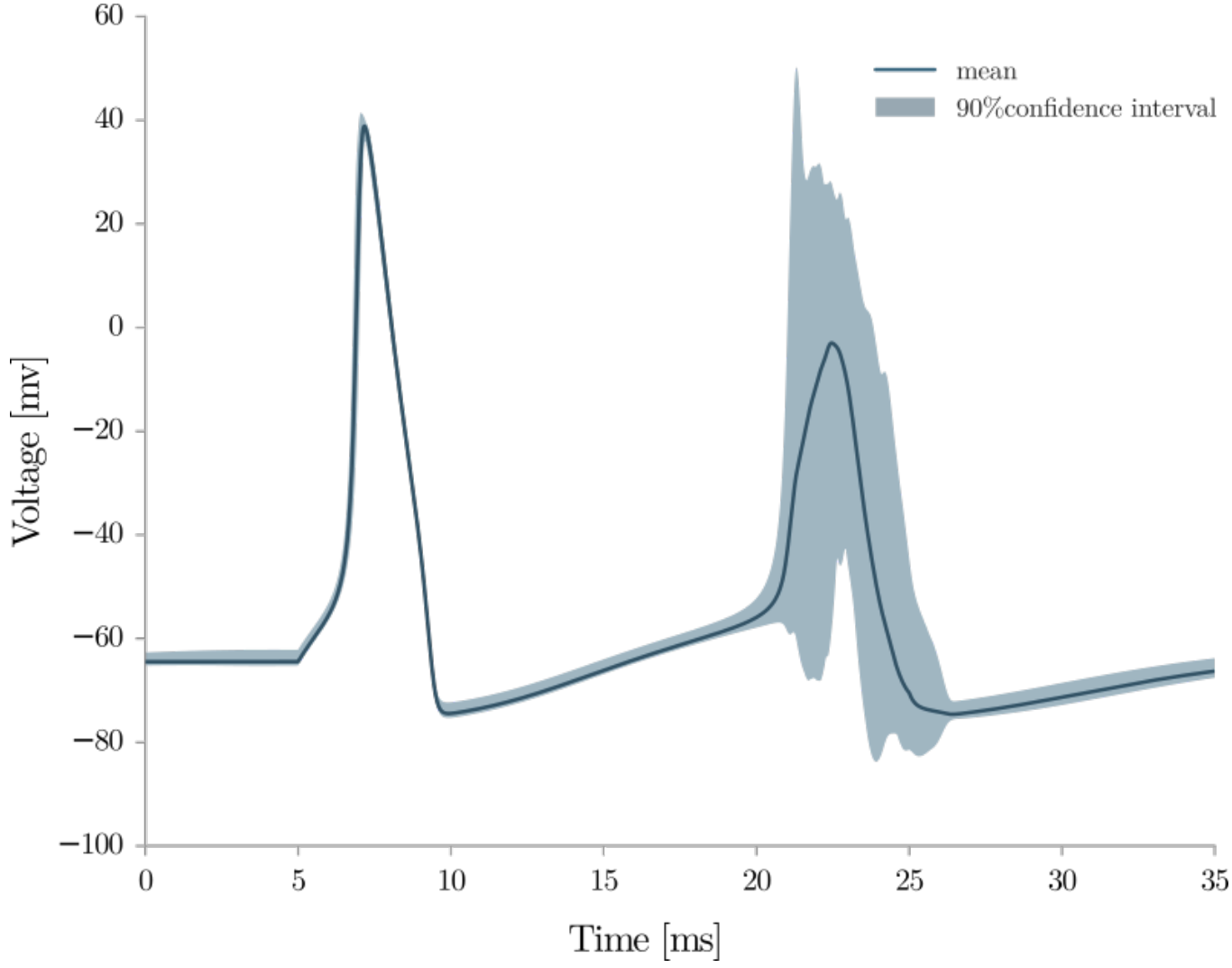
Quantify uncertainties

Creating a computational model consists of three steps, model creation, parameter estimation and uncertainty quantification



Quantify uncertainties

Result: Variations in an action potential (90% confidence interval)



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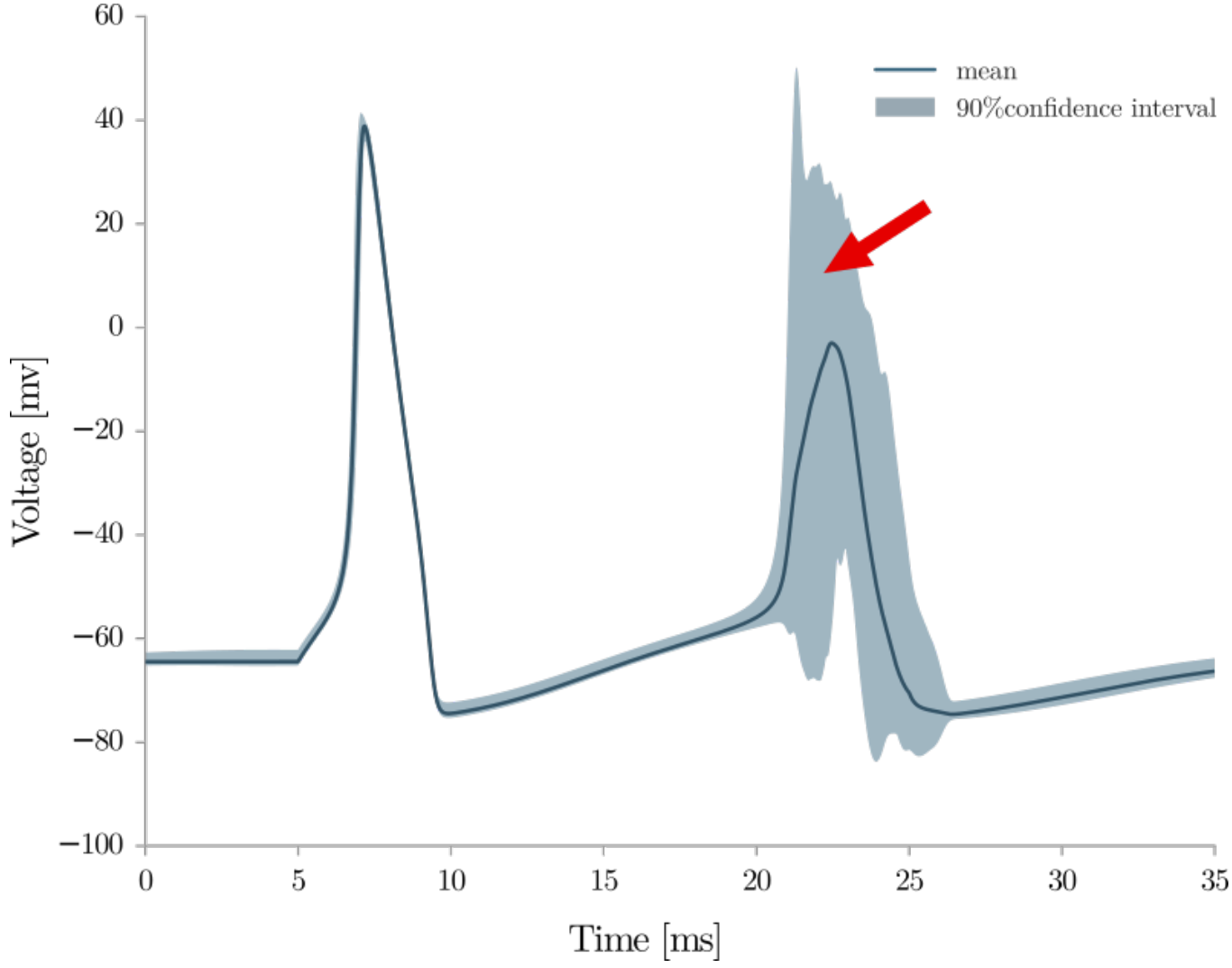
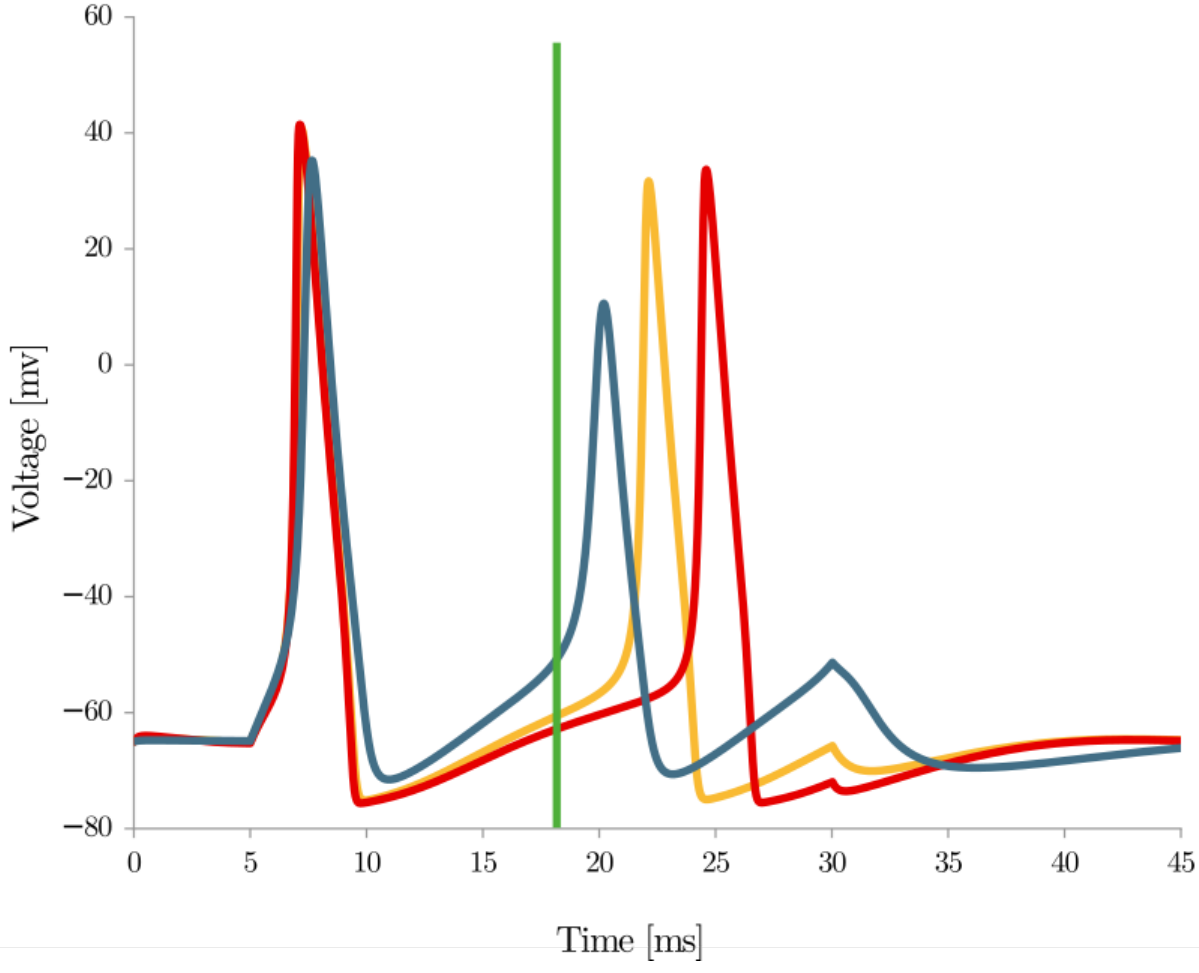
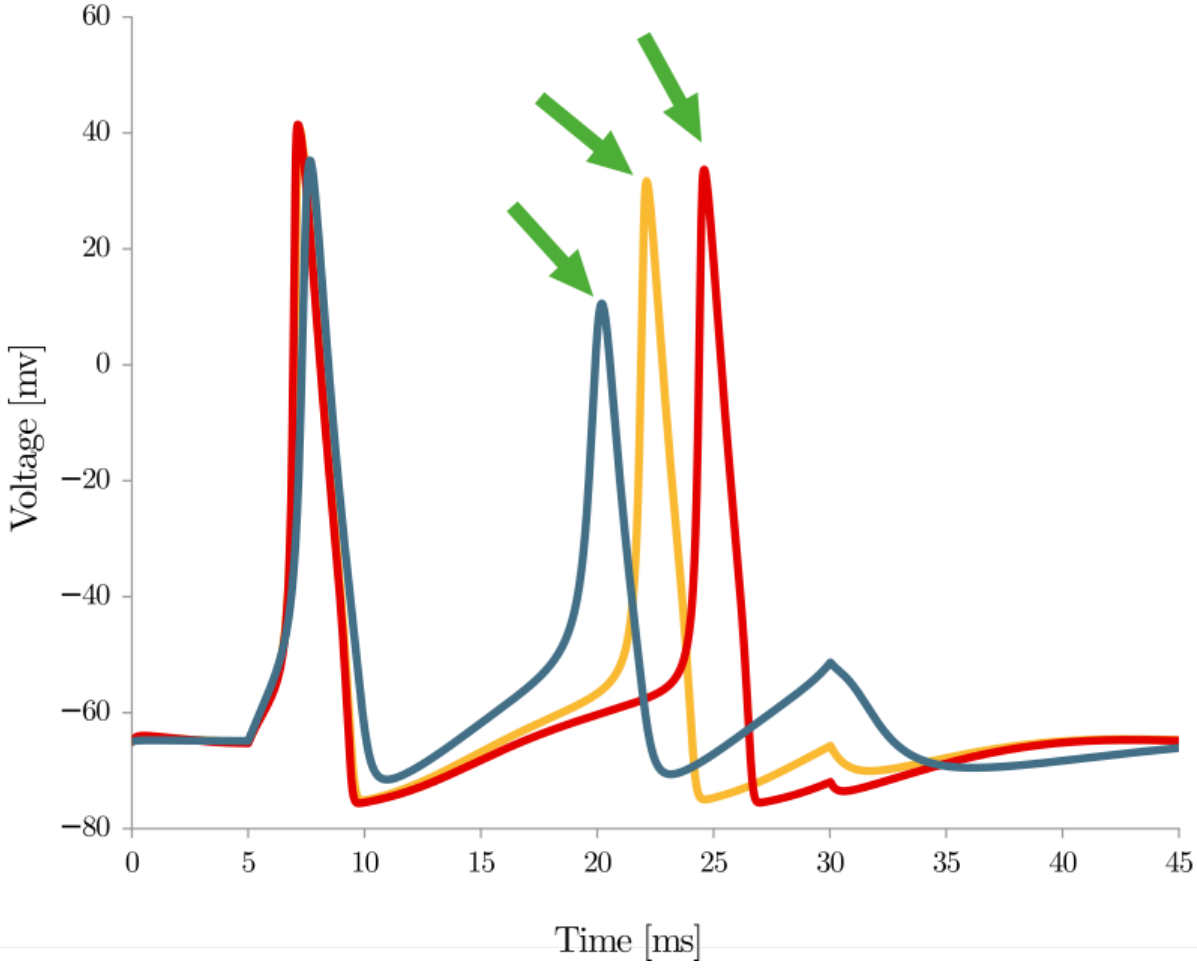


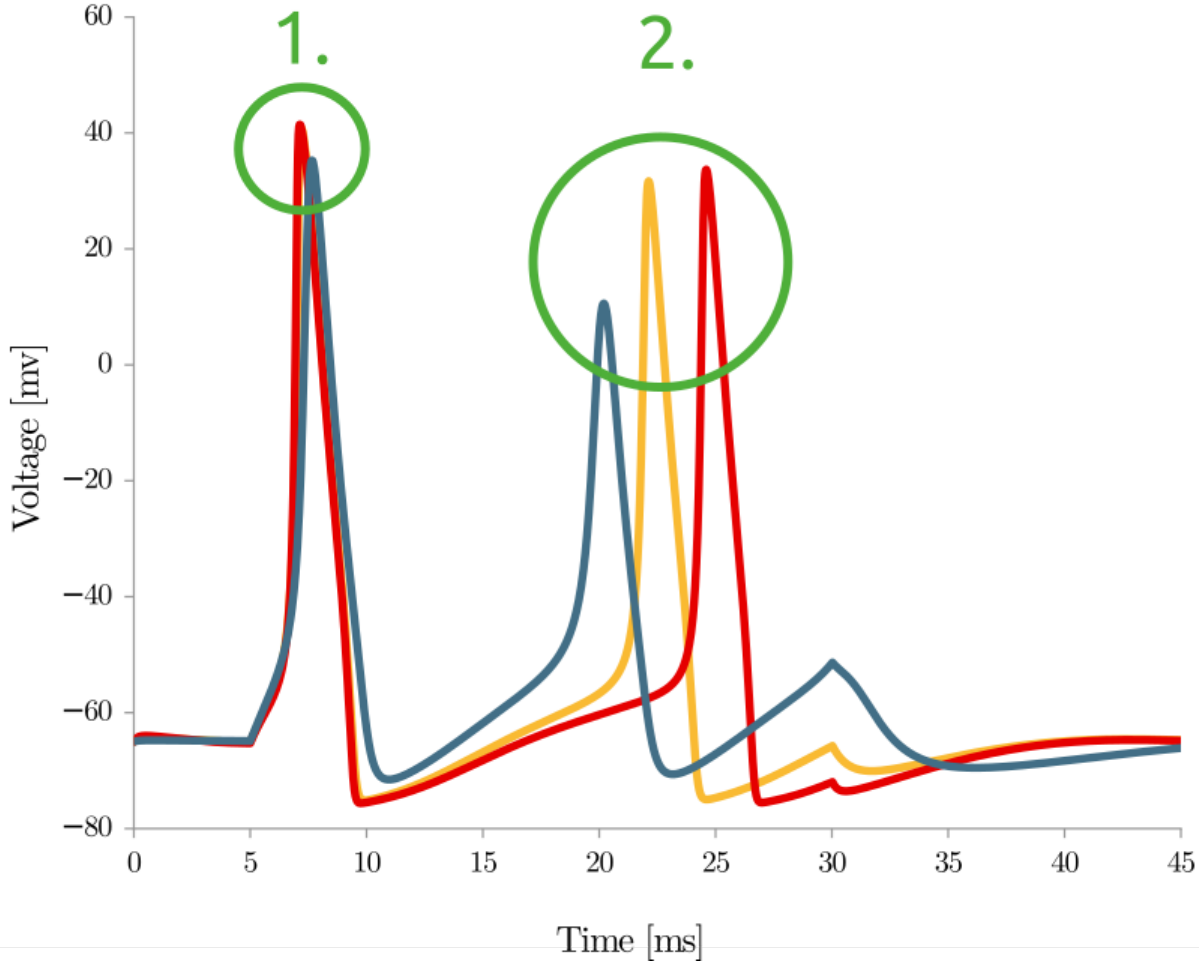
Pointwise comparison



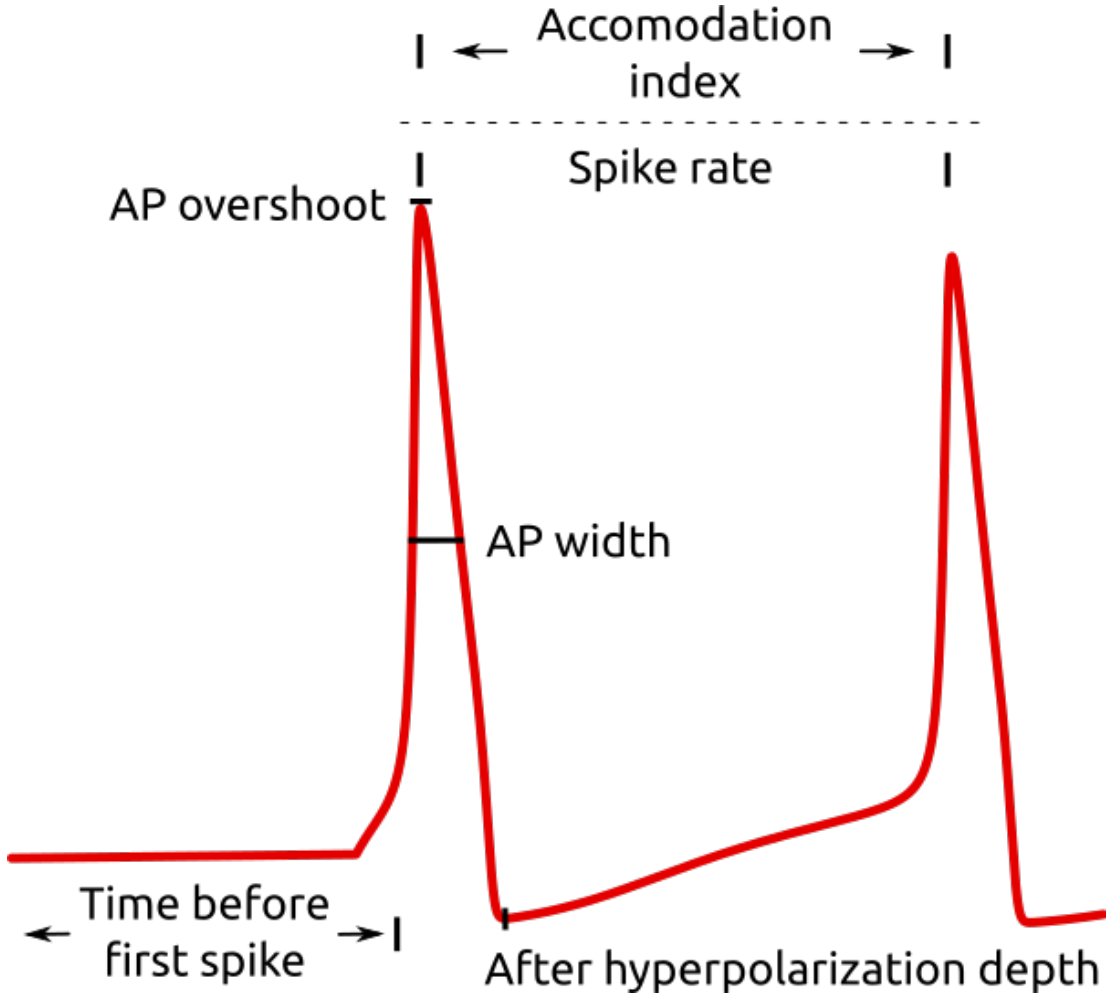
Pointwise comparison is problematic since ”the same” spike can occur at different times with different parameters



Solution: Calculate the uncertainty for features such as the number of spikes

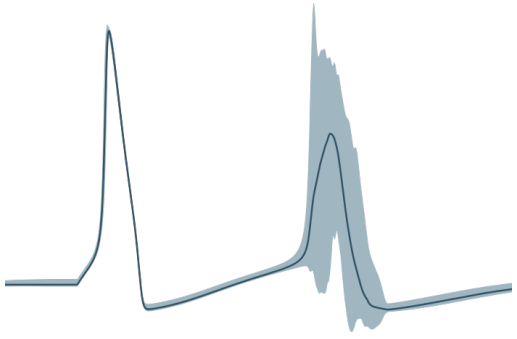


UncertainPy calculates the uncertainty for features such as the number of spikes

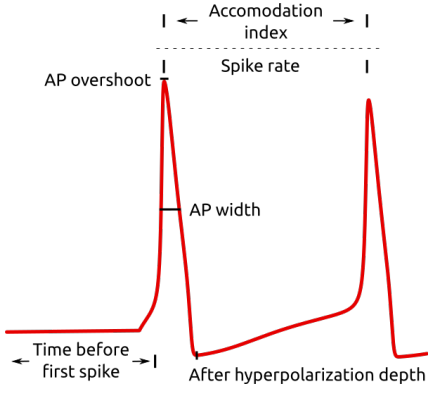


Summary: UncertainPy is a novel Python toolbox, tailored to perform uncertainty quantification in neuroscience models

UncertainPy calculates uncertainties of a model from uncertain parameters



UncertainPy is feature based



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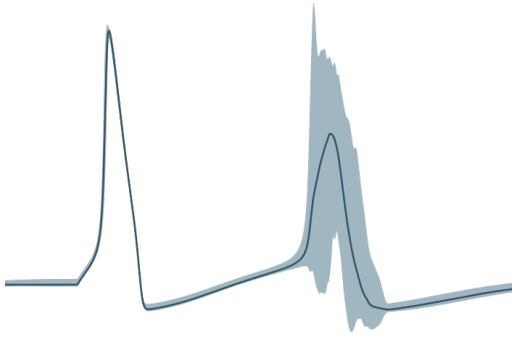

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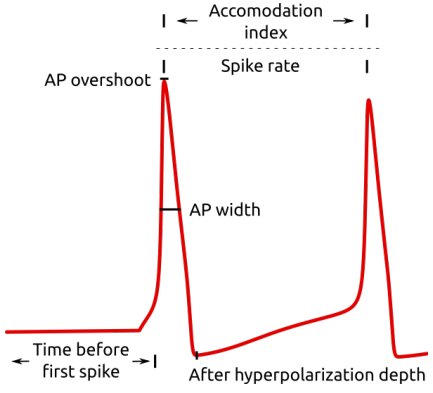

Spørsmål?