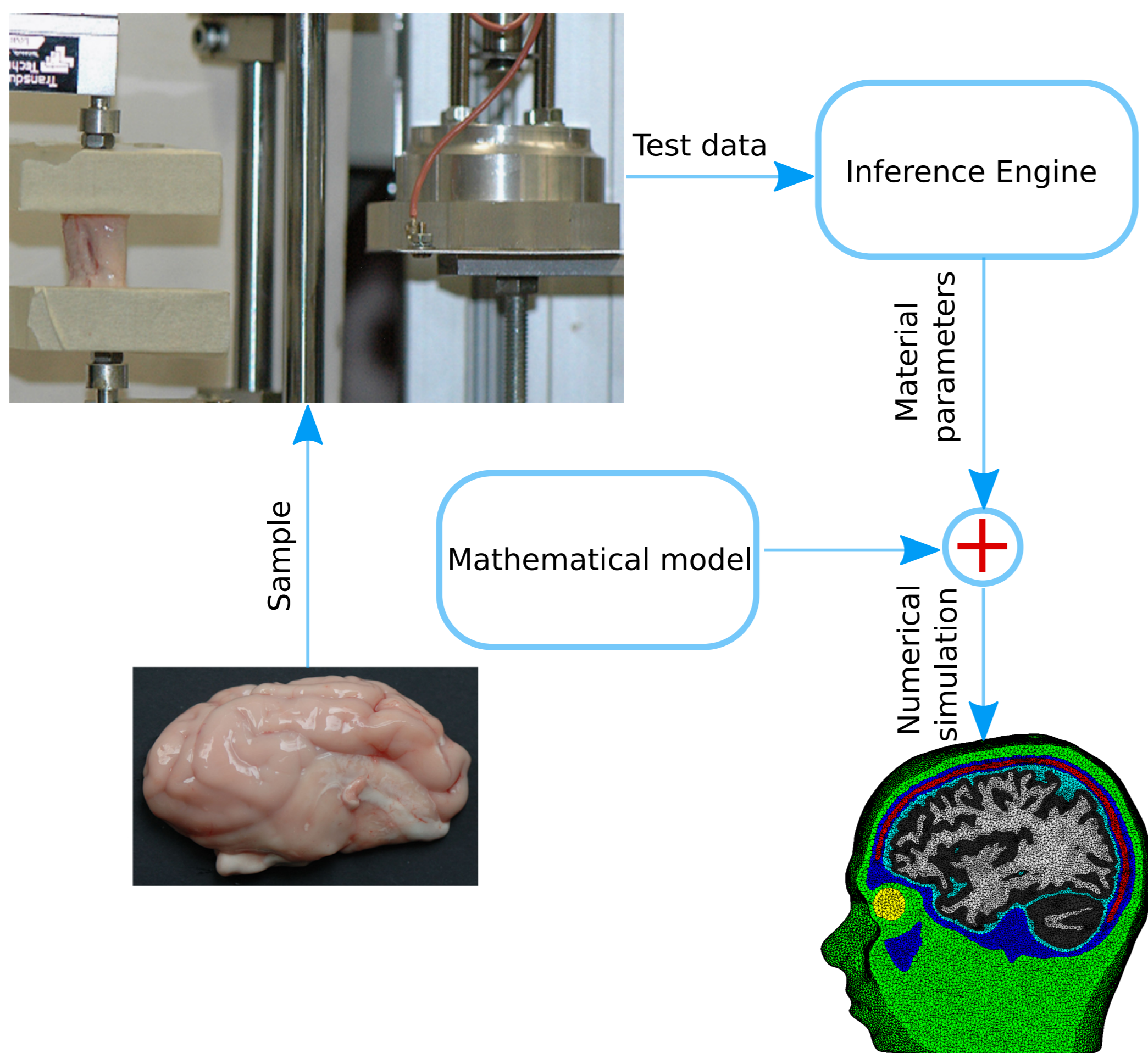


BAYESIAN INFERENCE FOR PARAMETER IDENTIFICATION IN COMPUTATIONAL MECHANICS

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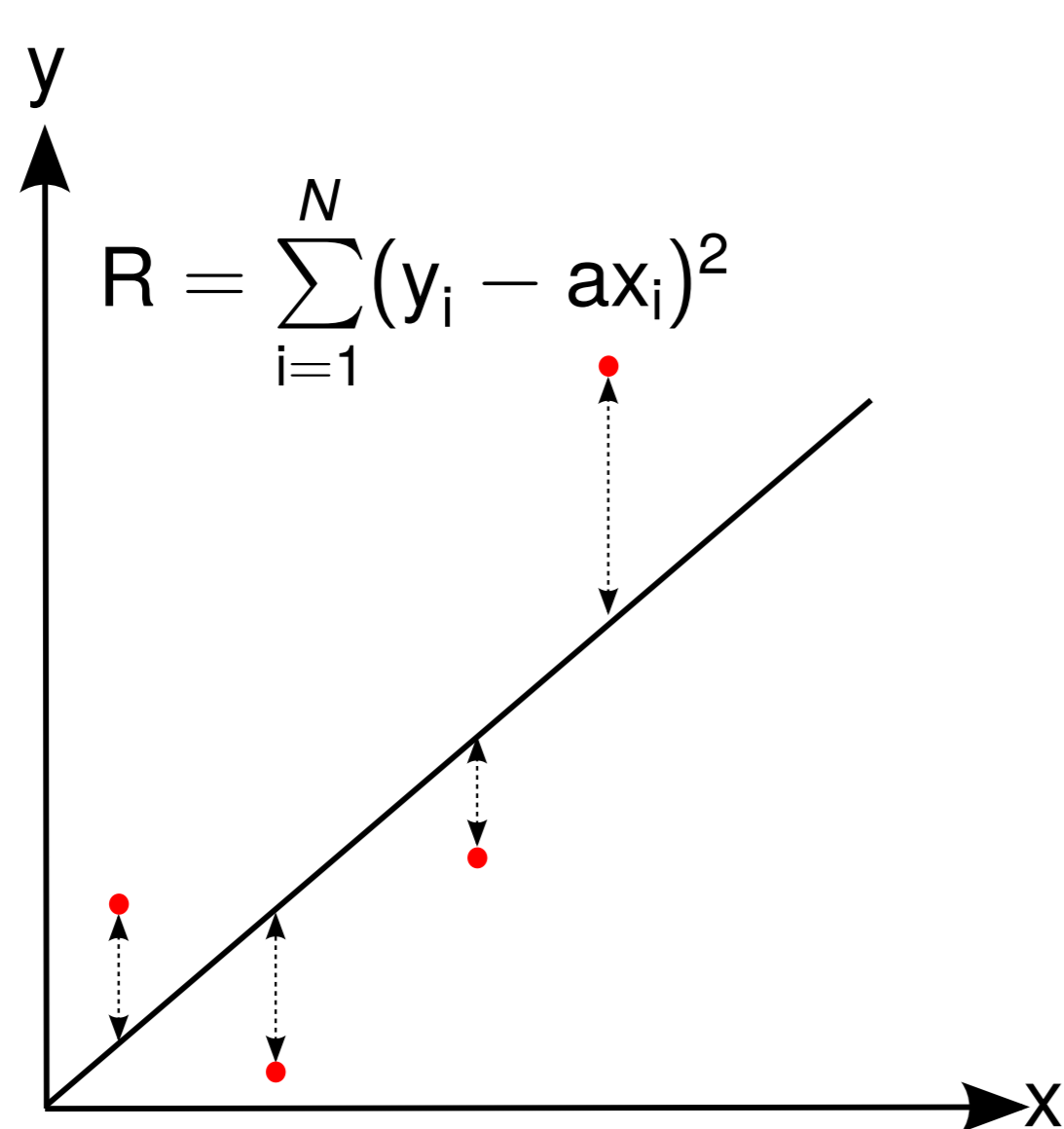
DETERMINING PATIENT-SPECIFIC MATERIAL PARAMETERS



The usual approaches that can fill in the *Inference Engine* box are:

- ▶ Least squares method (LSM),
- ▶ Maximum likelihood estimation (MLE) and
- ▶ Bayesian inference (BI).

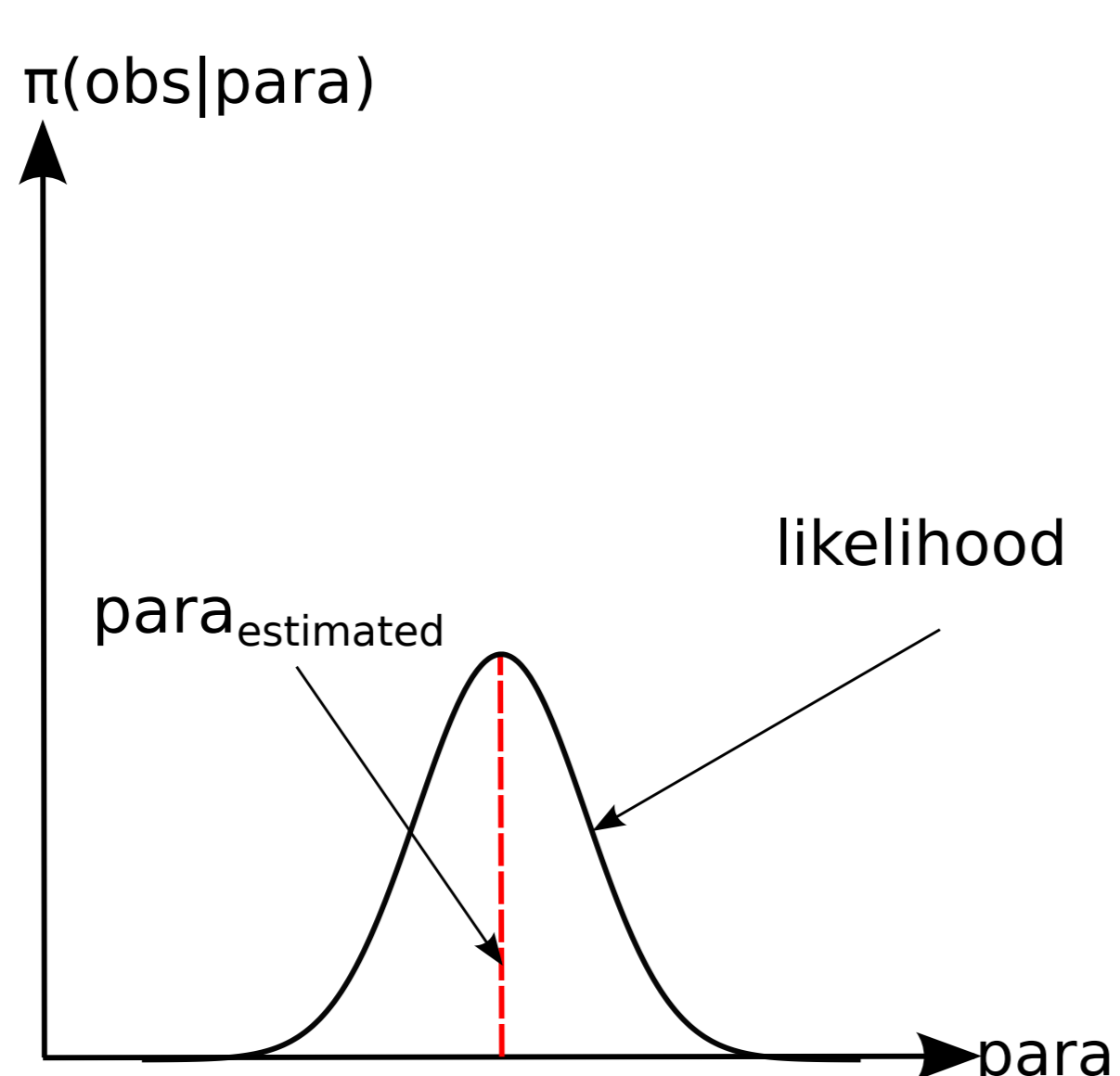
LEAST SQUARES APPROACH



The least squares method aims to minimise the residual R which is squared difference between the measured data (red dots) and model response (straight line). Some important points about this approach are:

- ▶ Easy to implement,
- ▶ Its out put for the parameter is number and
- ▶ The accuracy depends on the number of measurements and the employed model for regression.

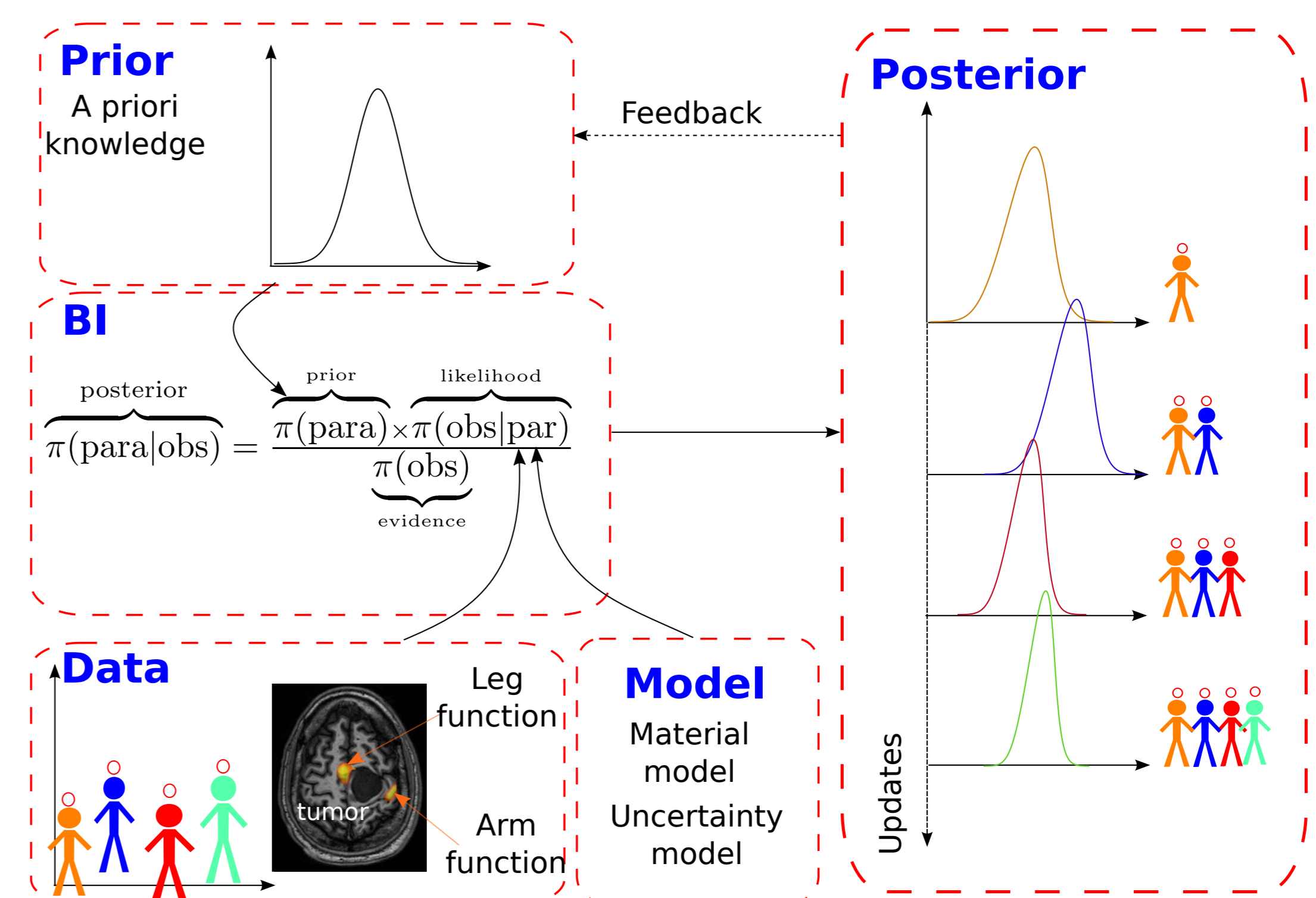
MAXIMUM LIKELIHOOD ESTIMATION



The idea of the maximum likelihood approach is to find the parameters in way that maximise the probability density function $\pi(obs|para)$. Some important points about MLE are:

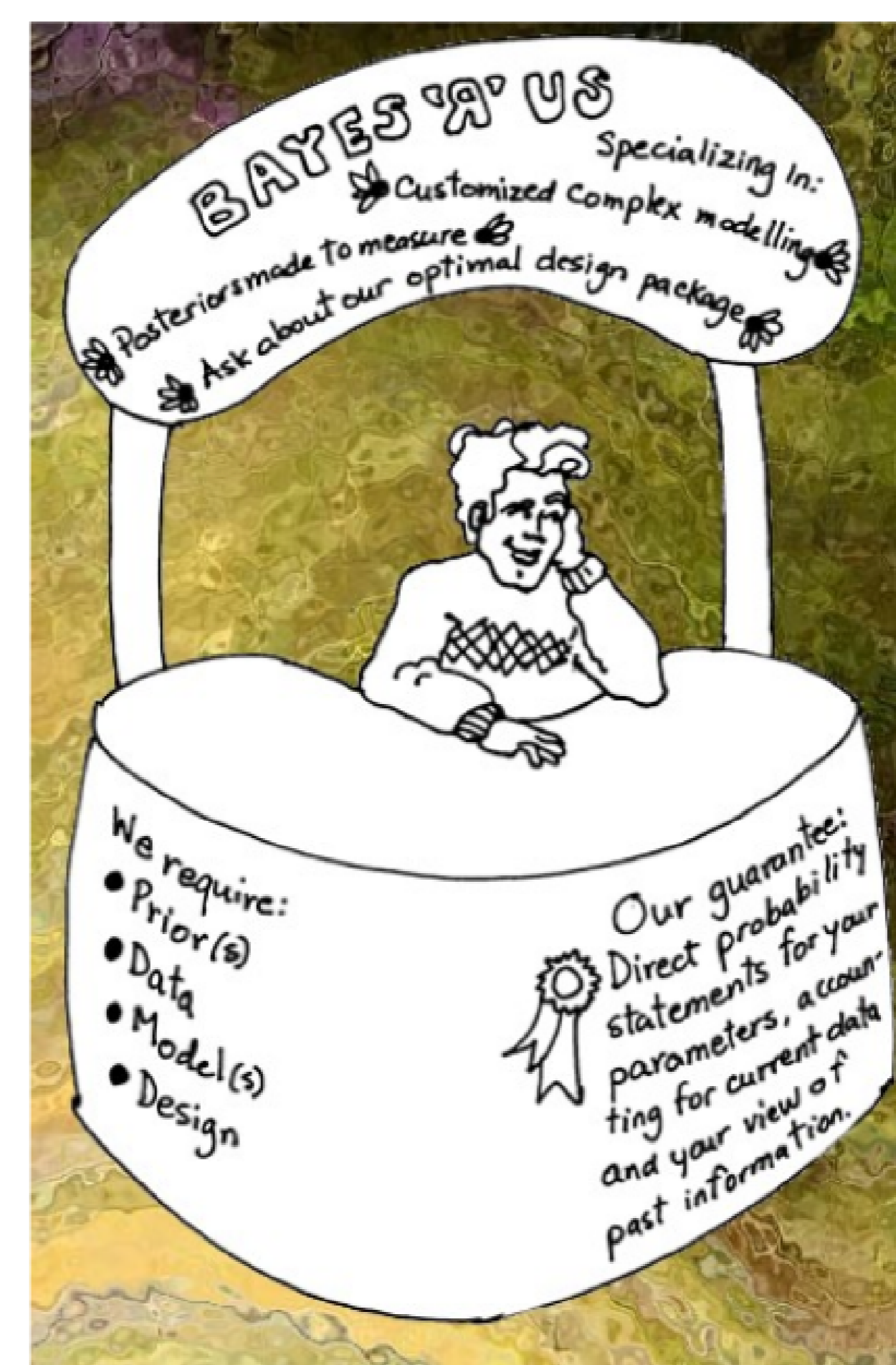
- ▶ Considers the experimental noises,
- ▶ Its out put for the parameter is number and
- ▶ The accuracy depends on the number of measurements and the employed model for regression.

BAYESIAN INFERENCE



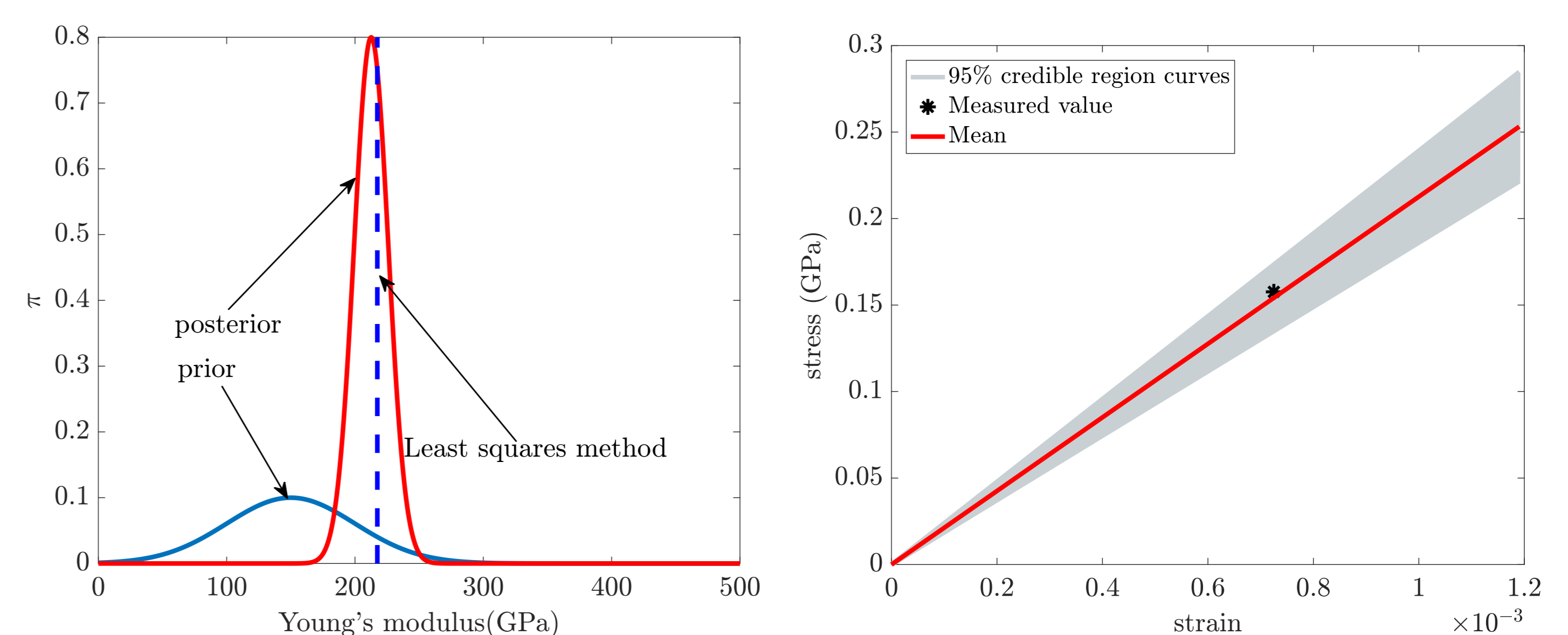
The Bayesian method is an alternative approach which *updates* ones original belief based on new observation, uncertainty model and mathematical model.

WHAT DOES BI OFFER?



<https://sofile.wordpress.com/tag/bayesian/>

RESULT



Rappel et al. 2016 (<http://hdl.handle.net/10993/28631>)

(Left) The prior, the posterior and the value predicted by least squares method. (Right) The measurements, and the stress-strain curves created using the posterior in left.

- ▶ The strain at which a measurement is made has a considerable influence on the posterior and
- ▶ The posterior also includes the estimate value by least squares method.