No title because you have to listen to me talk

Can I make regression with fancy lingo beat Eilmer?

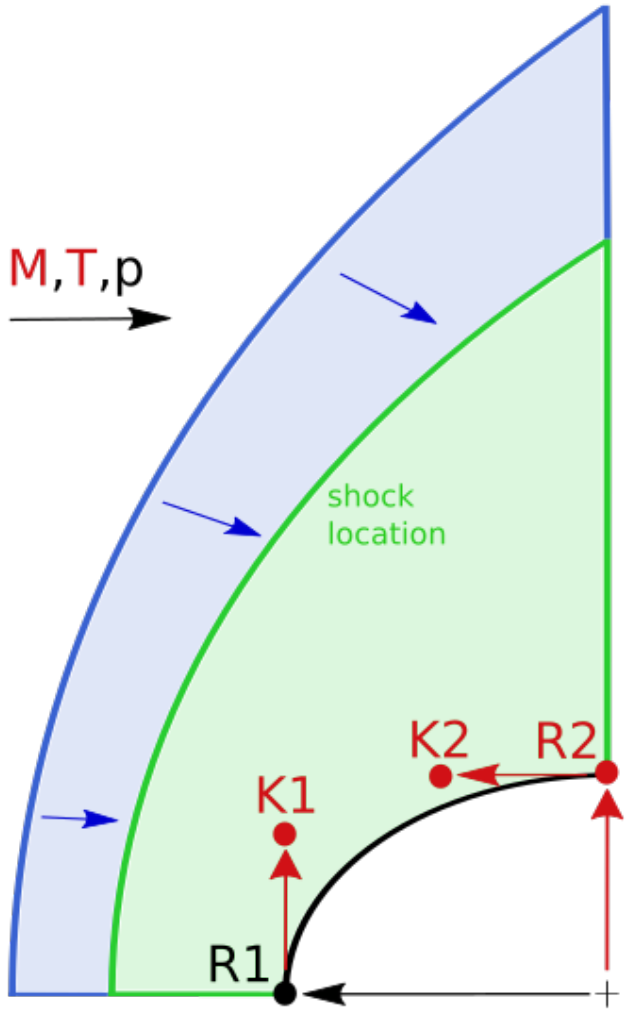
Machine Learning of Bow Shocks

Jamie Border

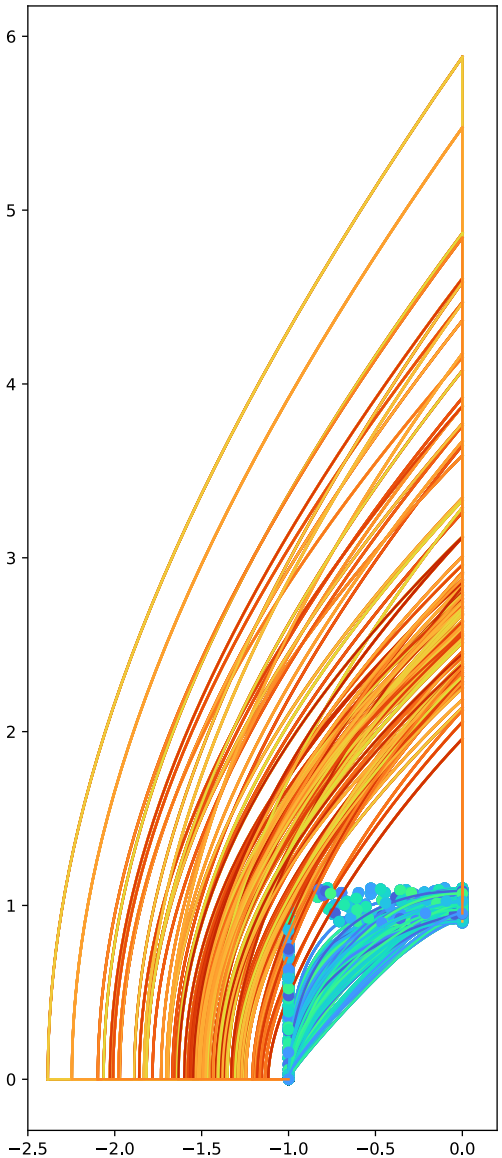
A Lightning Talk

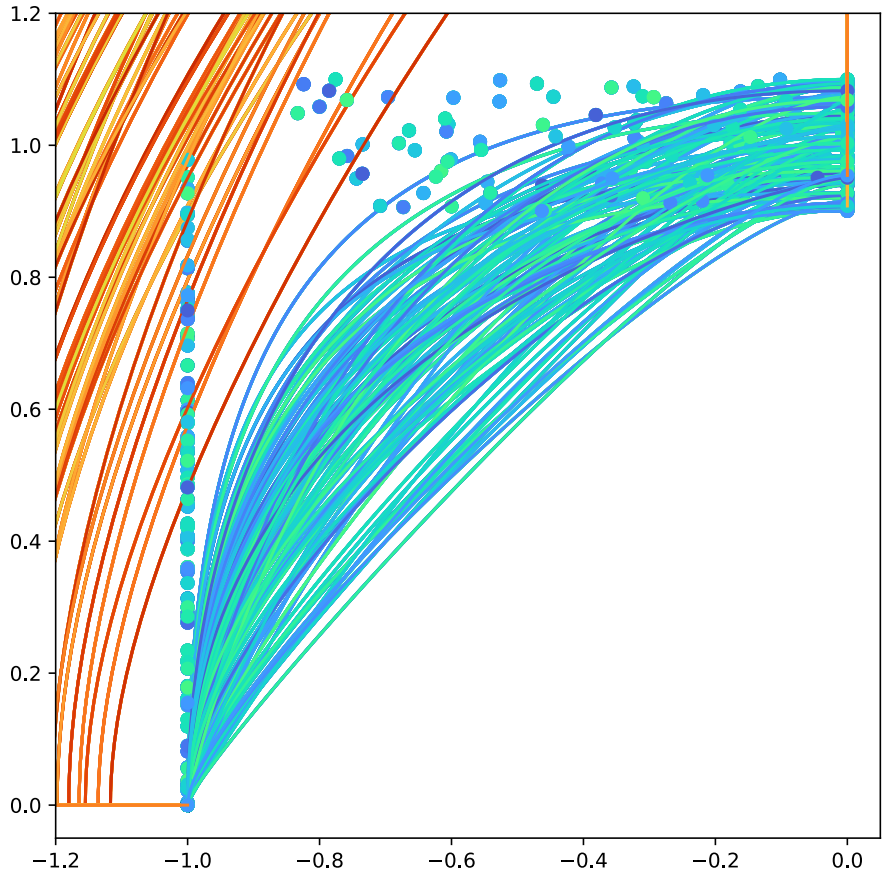
November 18th, 2022

Problem definition

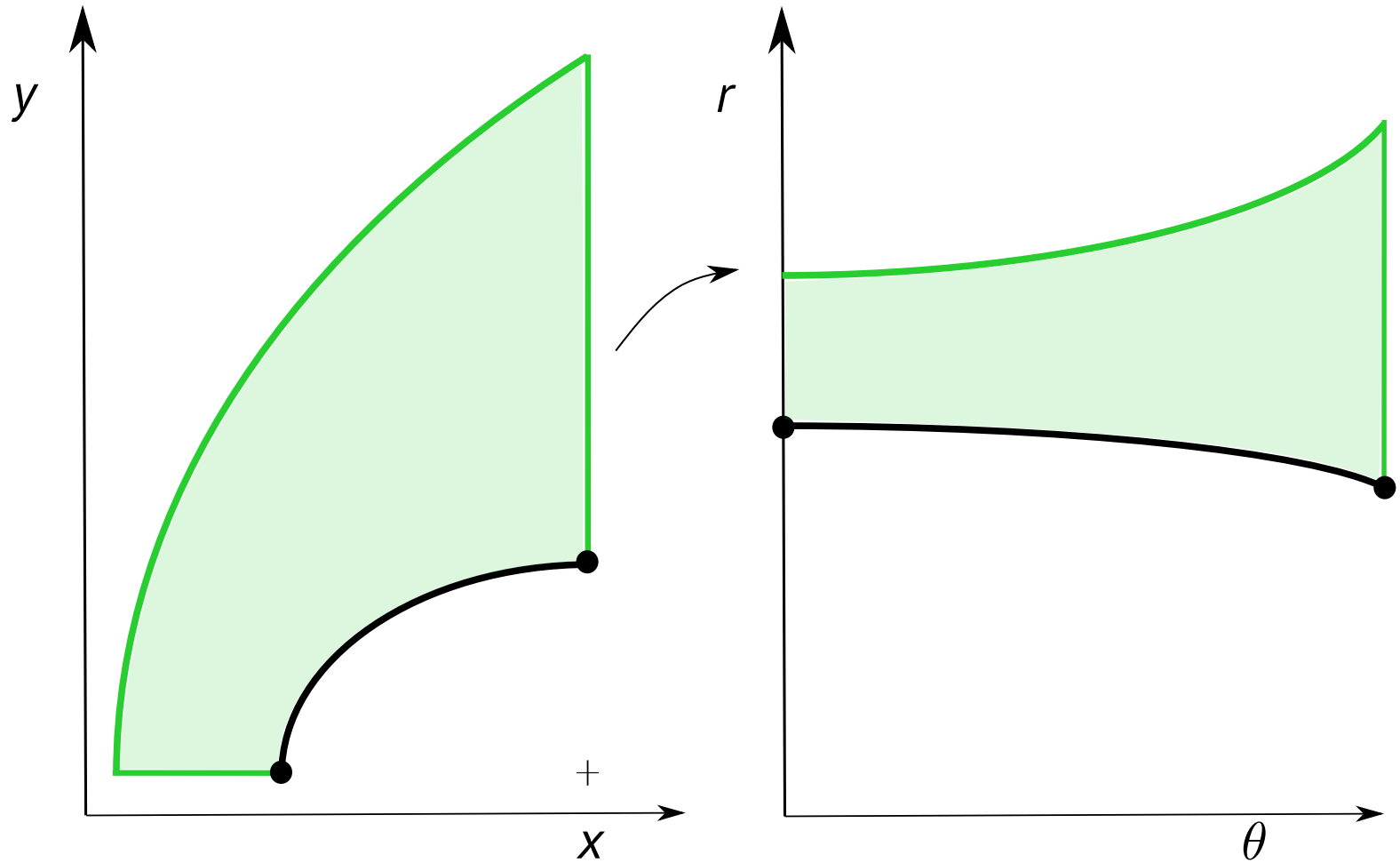


Randomly generated bodies and shock-fit bow shocks





Mapping from cartesian to polar coordinates



Fitting to shock data

$$r(\theta) = \sum_{k=0}^{m} a_k \theta^k \,, \qquad \frac{dr(\theta)}{d\theta} = \sum_{k=1}^{m} k a_k \theta^{k-1} \,, \qquad \theta = [0, \pi/2]$$

Least-squares fit,

$$I = \sum_{i=1}^{N} ||r(\theta_i) - r_i||^2 \,;$$

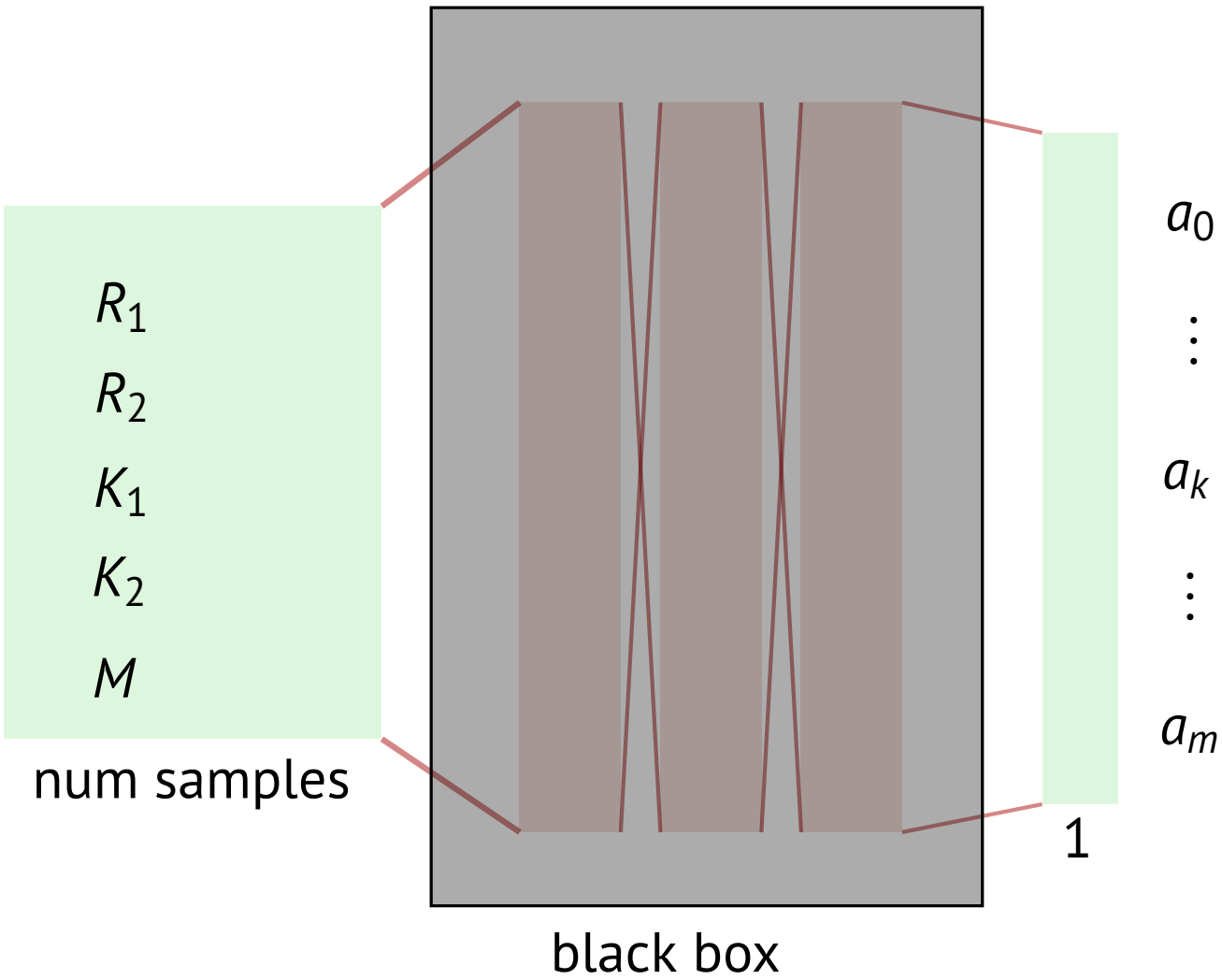
in matrix form, solving $I = (\boldsymbol{A}\boldsymbol{x} - \boldsymbol{b})^2$, giving

$$\boldsymbol{A}^T \boldsymbol{A} \boldsymbol{x} = \boldsymbol{A}^T \boldsymbol{b},$$

or if including gradient terms as constraints

$$\begin{bmatrix} \boldsymbol{A}^T \boldsymbol{A} & \boldsymbol{C}^T \\ \boldsymbol{C} & \boldsymbol{0} \end{bmatrix} \begin{bmatrix} \boldsymbol{x} \\ \boldsymbol{\lambda} \end{bmatrix} = \begin{bmatrix} \boldsymbol{A}^T \boldsymbol{b} \\ \boldsymbol{d} \end{bmatrix} .$$

ML



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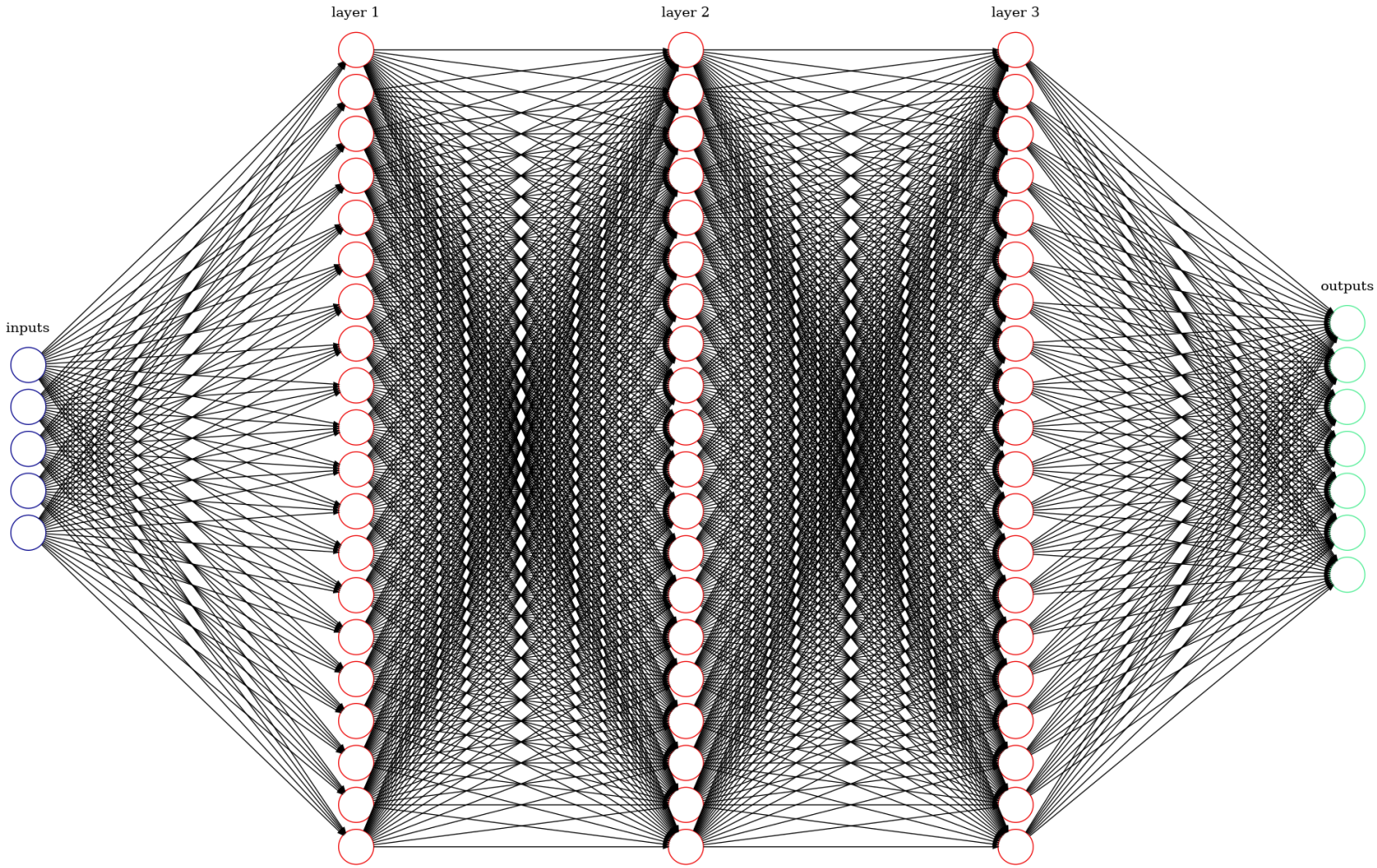
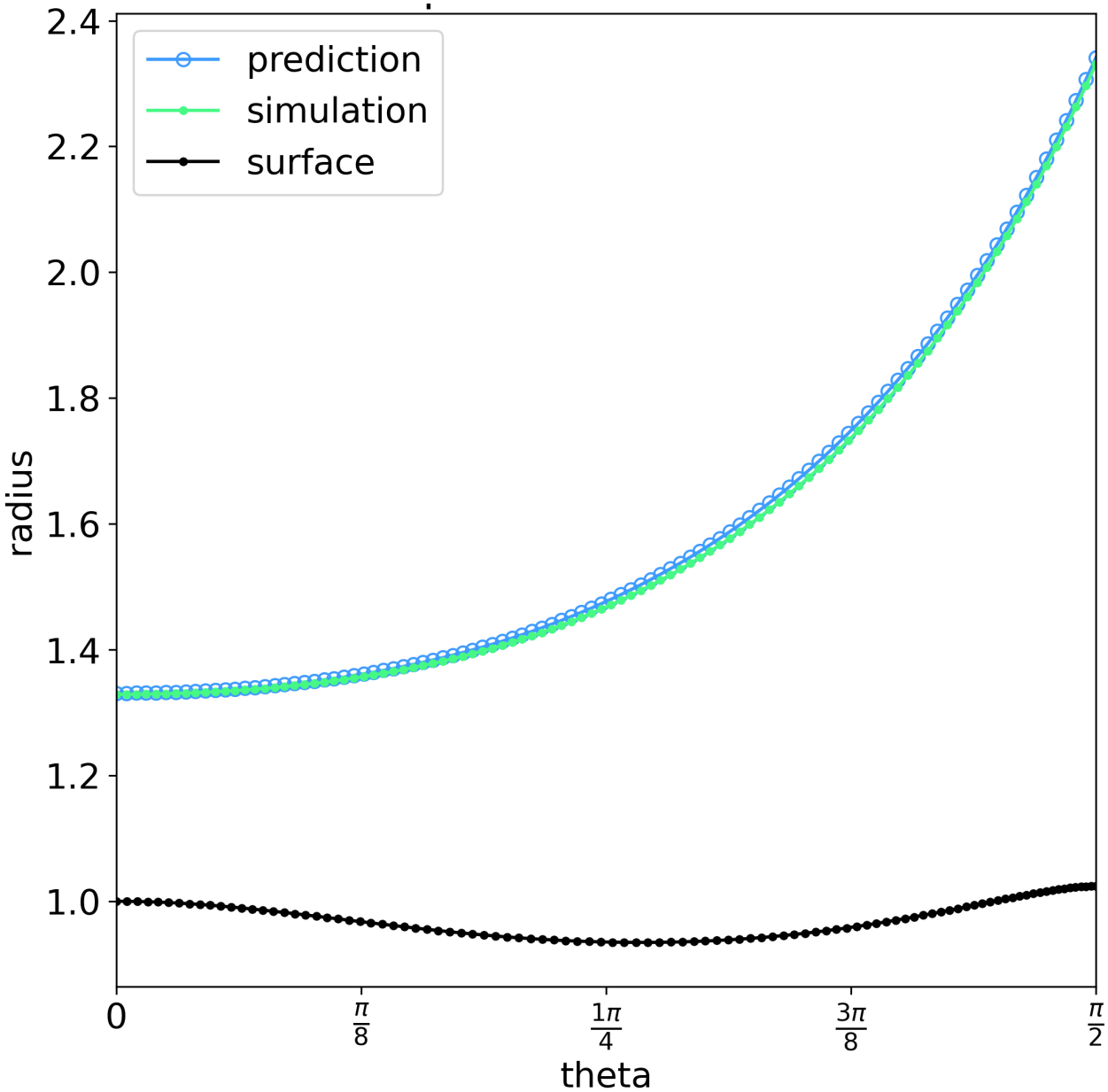


Example fit in polar coordinates



Example fit in cartesian coordinates