Synthetic Biology and Biosystems Control Lab
Valencia UPV

2020
Measurement

Modeling: ODEs and Hill Functions

Section 3: Hill function examples and intuitions

by Alejandro Vignoni (alvig2@upv.es)

An iGEM Measurement Committee Webinar

Week 2, June 23rd, 2020

$$\begin{cases} \frac{d[LuxI]_i}{dt} = b_i + u([AHL]_i) - \gamma_I [LuxI]_i \\ \frac{d[AHL]_i}{dt} = K_A [LuxI]_i + d([AHL]_i - [AHL]_e) - \gamma_A [AHL]_i \end{cases}$$

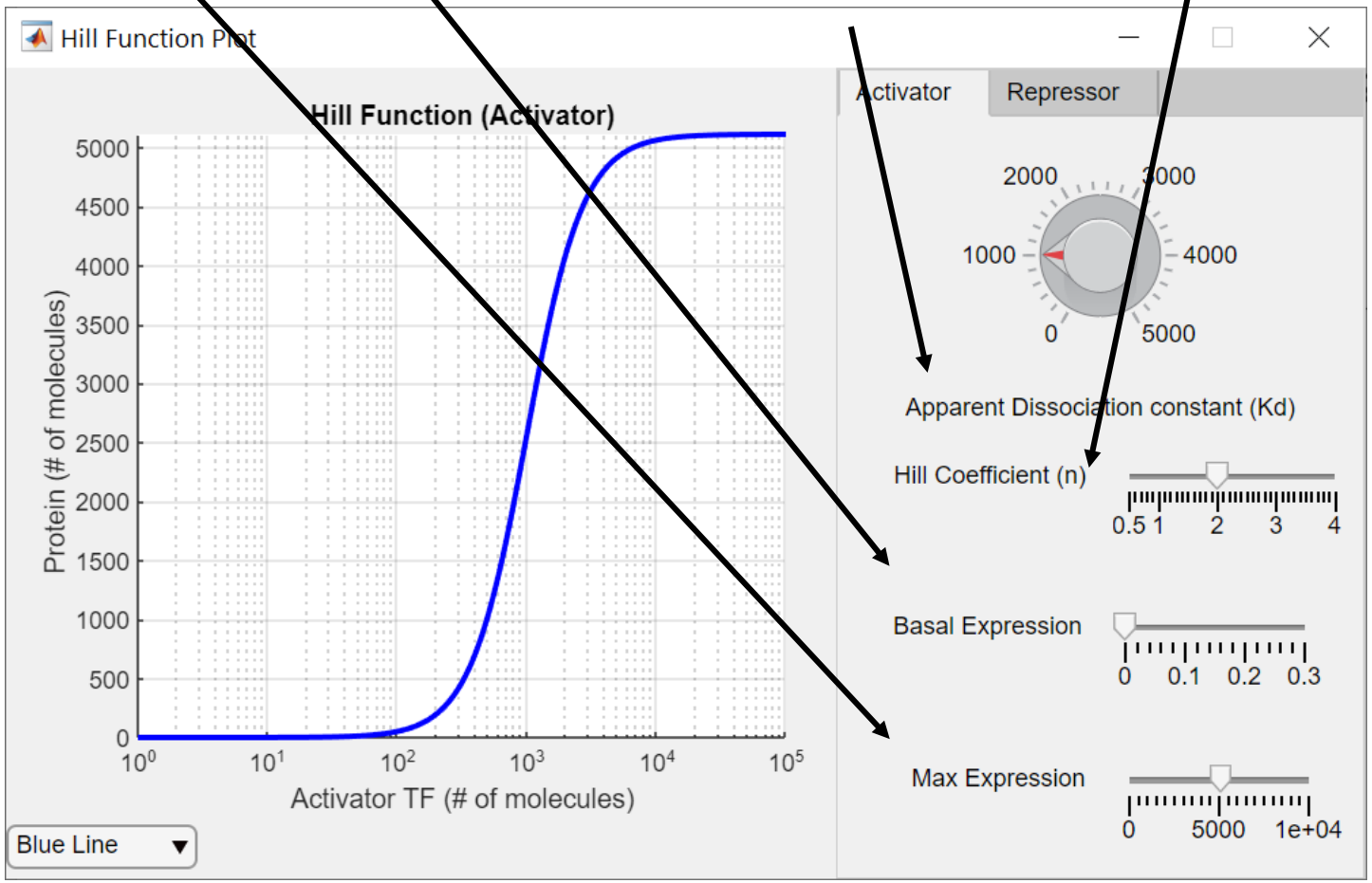
Today Webinar's Topics

- Section 1: ODEs, the law of mass action, and the central dogma (15 min)
- Section 2: Derivation of a Hill function from the law of mass action (15 min)
- Section 3: Hill function examples and intuitions: effects of parameters on activators, repressors, hybrid promoters, using a Matlab exploration package. (15min)
- Q&A – (at the end of each 15 minutes block, total 15 min)

Gene expression regulation by Transcription Factors (TF)

Activator

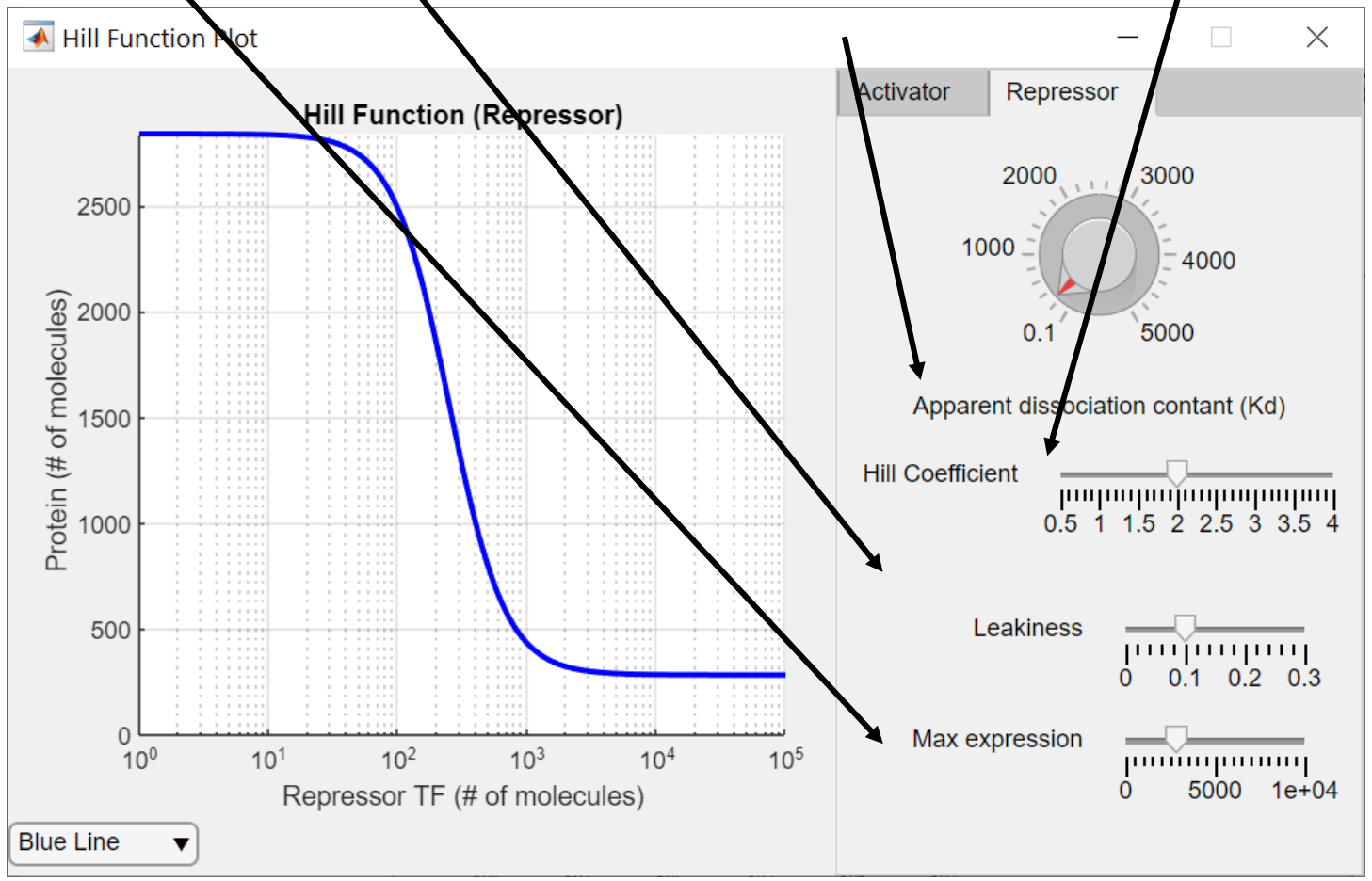
$$[\text{Protein}] = \alpha_{max}\left(\beta_0 + (1-\beta_0)\frac{[\text{TF}]^n}{K_d + [\text{TF}]^n}\right) \qquad \alpha_{max} = k_2\frac{k_1}{d_1 d_2}C_N$$



Gene expression regulation by Transcription Factors (TF)

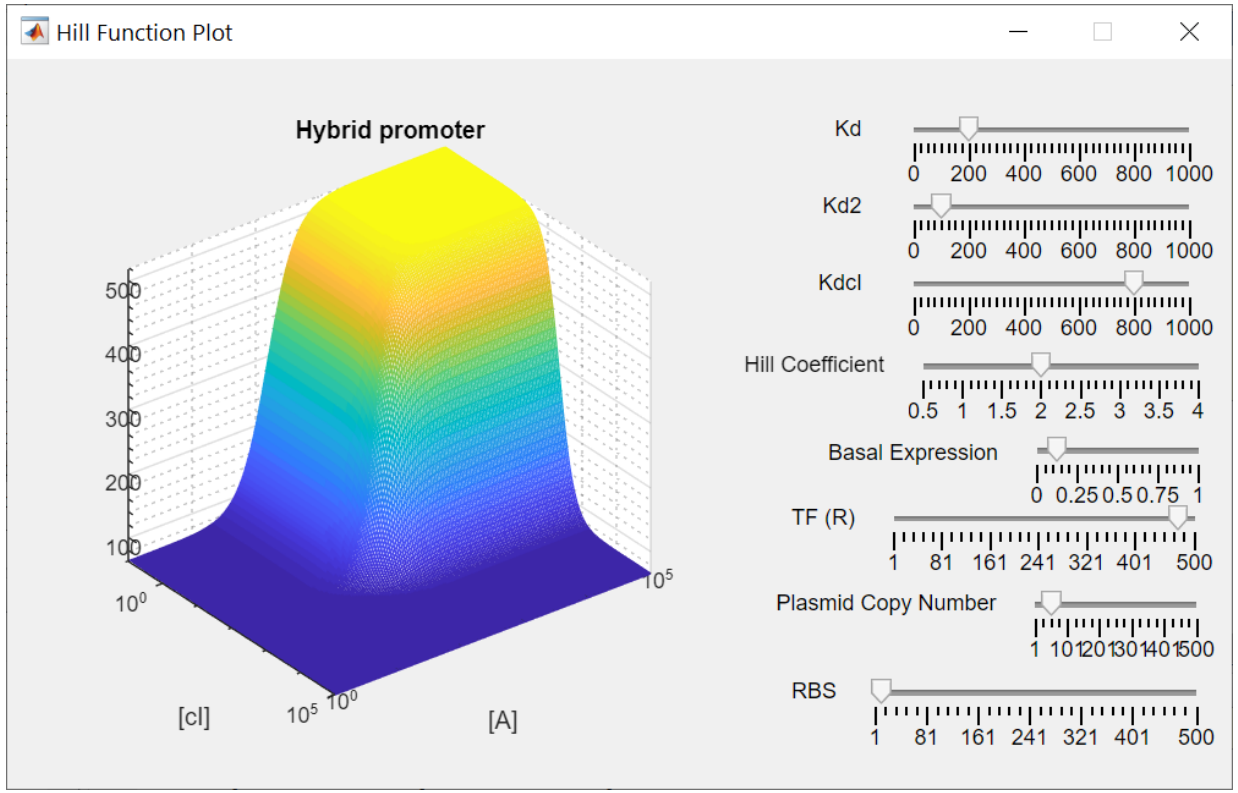
Repressor

$$[\text{Protein}] = \alpha_{max}\left(\beta_0 + (1-\beta_0)\frac{K_d}{K_d + [\text{TF}]^n}\right) \qquad \alpha_{max} = k_2\frac{k_1}{d_1 d_2}C_N$$



Gene expression regulation by Transcription Factors (TF)
Hybrid Promoter

$$[\text{Protein}] = \alpha_{max}\left(\beta_0 + (1-\beta_0)\frac{\frac{1}{k_{dlux}}\left(\frac{[R][A]}{k_{d2}C_N}\right)^2}{1+\frac{1}{k_{dlux}}\left(\frac{[R][A]}{k_{d2}C_N}\right)^2}\frac{1}{1+\frac{[cI]^2}{k_{dcI}C_N}}\right)$$



Questions?
Contact me by email (alvig2 [at] upv [dot] es)

Thank You & Have an Exceptional Year of iGEM!

Next Modeling seminar
Week 3a Modeling circuits with ODEs and experimental data,
stay tuned!

Go check out the Measurement Hub!
https://2020.igem.org/Measurement