Exercise: Instabilities in Dynamic Fields

The neural field dynamics of Amari are based on this equation:

$$\tau \dot{u}(x,t) = -u(x,t) + h + S(x,t) + \int dx'\ w(x-x')\ \sigma(u(x'))$$

The sigmoidal function is given by

$$\sigma(u) = \frac{1}{1+\exp[-\beta\ u]}.$$

The interaction kernel is given by

$$w(x-x') = -w_{\text{inhib}} + w_{\text{excite}}\ \exp\left[-\frac{(x-x')^2}{2\sigma^2_{\text{excite}}}\right].$$

Input localized around x_{input} is supplied in the form

$$S(x,t) = S_{\text{strength}} \exp\left[-\frac{(x-x_{\text{input}})^2}{2\sigma^2_{\text{input}}}\right].$$

Use the interactive simulator `interactive_sim1l.m` to reproduce the instabilities we discussed in the lecture.

1. Detection instability and reverse detection: increase localized input strength, S_{input} and then decrease it again.

2. Selection: Provide two localized inputs and vary their relative strength. Observe stabilization of a selection decisions.

3. Boost induced detection: Supply small subthreshold input and increase resting level.

4. Selection of categorical response: Provide two localized inputs of identical strength below threshold. Increase reasing level. Vary noise to see how either category is selected.

5. Memory instability: vary resting level and probe if self-stabilized peaks are sustained.