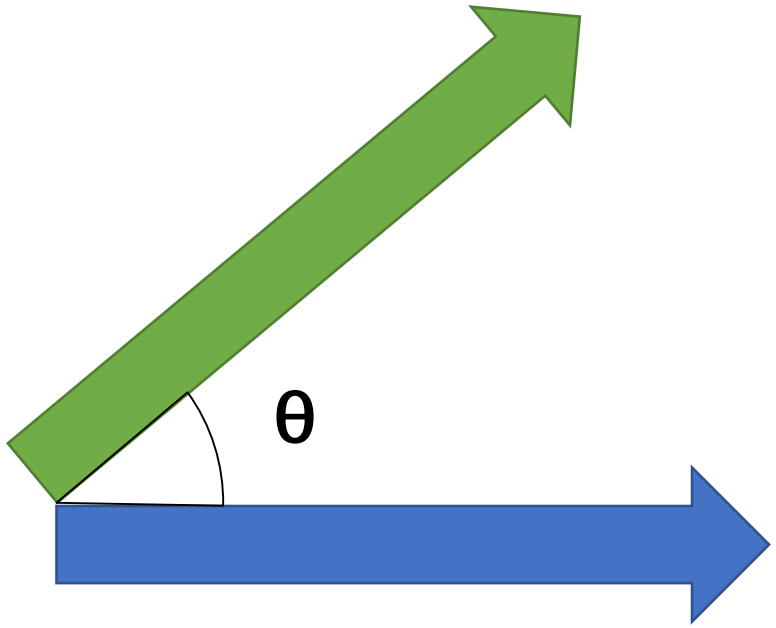
Simulation GUI Demo

Fei Wang, 9/5/2019

Two directions, two components



Main Function: von Miser Function

- The von Mises probability density function for the angle *x* is given by:

$$f(x \mid \mu, \kappa) = \frac{e^{\kappa \cos(x-\mu)}}{2\pi I_0(\kappa)}$$

where $I_0(\kappa)$ is the modified Bessel function of order 0.

von Mises distribution, wikipedia, https://en.wikipedia.org/wiki/Von_Mises_distribution

Main Function: von Miser Function

$$f(x \mid \mu, \kappa) = \frac{e^{\kappa \cos(x-\mu)}}{2\pi I_0(\kappa)}$$

- For Component 1:

$$R_1(\theta_1) = A_1 + B_1 e^{C_1[cos(PD-\theta_1)]}$$

- For Component 2:

$$R_2(\theta_2) = A_2 + B_2 e^{C_2[cos(PD-\theta_2)]}$$

PD represents angle *x* in the former slide.

Main Function: von Miser Function

- The model:

$$R_1(\theta_1) = A_1 + B_1 e^{C_1[cos(PD-\theta_1)]}$$

$$R_2(\theta_2) = A_2 + B_2 e^{C_2[cos(PD-\theta_2)]}$$

$$R(\theta_1, \theta_2) = \omega_1 \cdot R_1(\theta_1) + \omega_2 \cdot R_2(\theta_2) + b \cdot R_1(\theta_1) \cdot R_2(\theta_2)$$

Weighting Parameters

Main Function: von Miser Function

- The model:

$$R_1(\theta_1) = A_1 + B_1 e^{C_1[cos(PD-\theta_1)]}$$

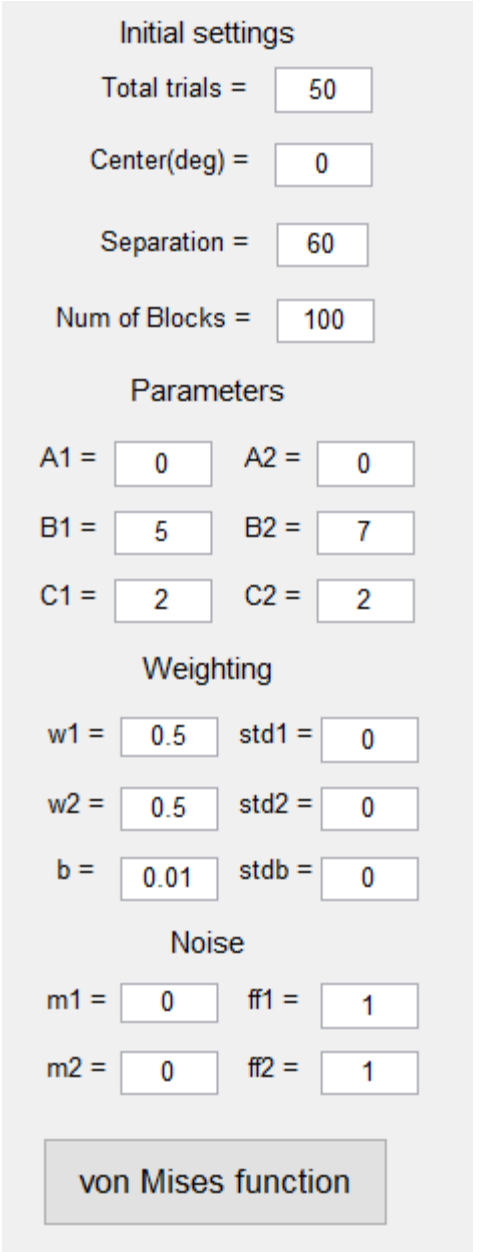
$$R_2(\theta_2) = A_2 + B_2 e^{C_2[cos(PD-\theta_2)]}$$

$$R(\theta_1, \theta_2) = \omega_1 \cdot R_1(\theta_1) + \omega_2 \cdot R_2(\theta_2) + \boxed{b \cdot R_1(\theta_1) \cdot R_2(\theta_2)}$$

Interaction

Step 1: Setting Parameters

- **Initial settings**
- Total trials: The number of trials.
- Center angle: The angle that a neuron is most sensitible to.
- Separation: The angle between the first component and the second.
- Num of blocks: It is only used to verify whether the fitting parameters follow the Gaussian Distribution.

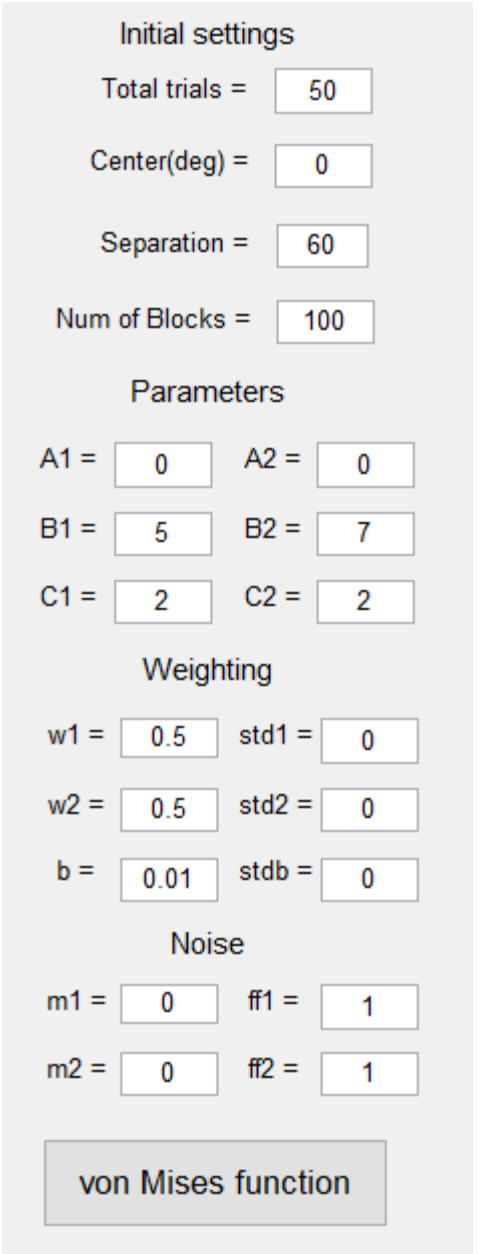


Step 1: Setting Parameters

- **Parameters**

$$R_1(\theta_1) = A_1 + B_1 e^{C_1[cos(PD-\theta_1)]}$$

$$R_2(\theta_2) = A_2 + B_2 e^{C_2[cos(PD-\theta_2)]}$$

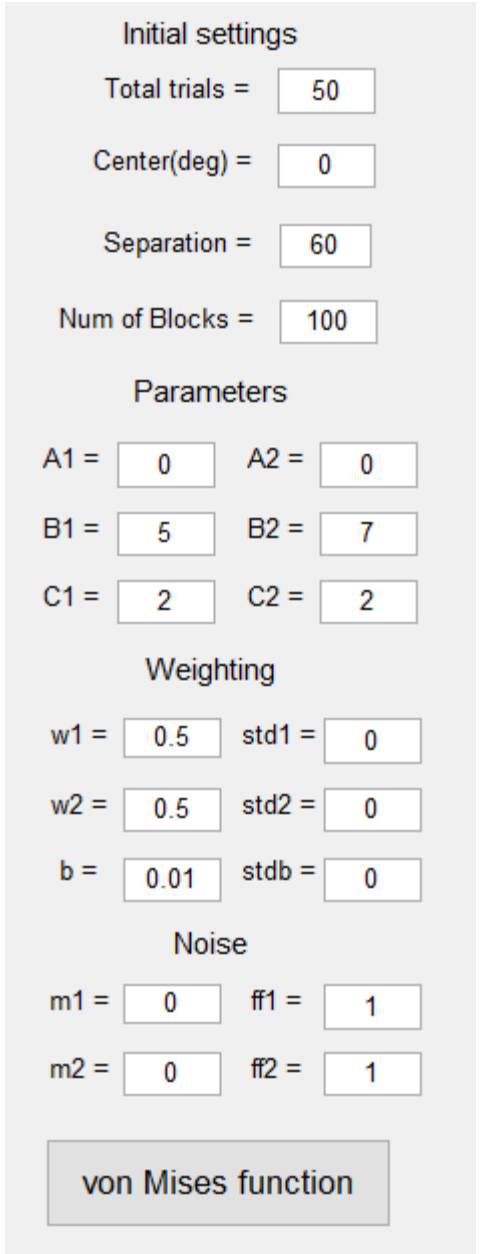


Step 1: Setting Parameters

- **Weighting**
- Three parameters are generated by setting the mean value and the variance of a Gaussian Distribution.
- w_1, w_2, b: Mean value of the parameters.
- std_1, std_2, std_b: Standard deviations respectively.

$$R(\theta_1, \theta_2) = \boxed{\omega_1} \cdot R_1(\theta_1) + \boxed{\omega_2} \cdot R_2(\theta_2) + \boxed{b} \cdot R_1(\theta_1) \cdot R_2(\theta_2)$$

Weighting Parameters

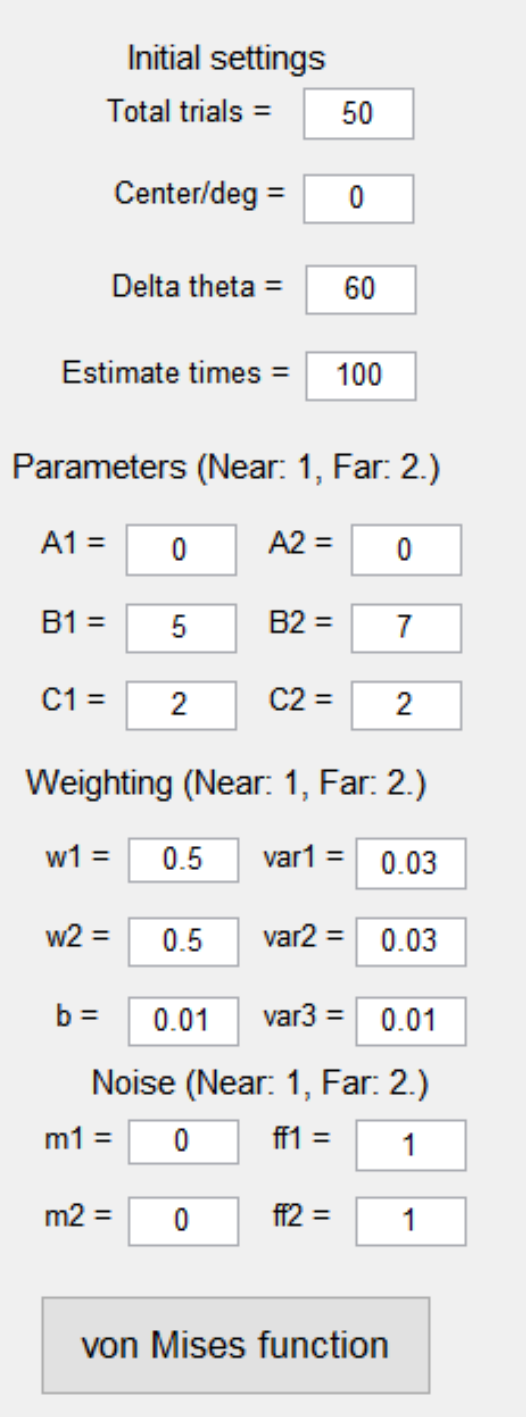


Step 1: Setting Parameters

- **Noise**
- Noise added on R_1, R_2 by setting the mean value and the variance of a Gaussian Distribution.
- m_1, m_2: Mean values of the parameters.
- ff_1, ff_2: Coefficients of variation respectively.

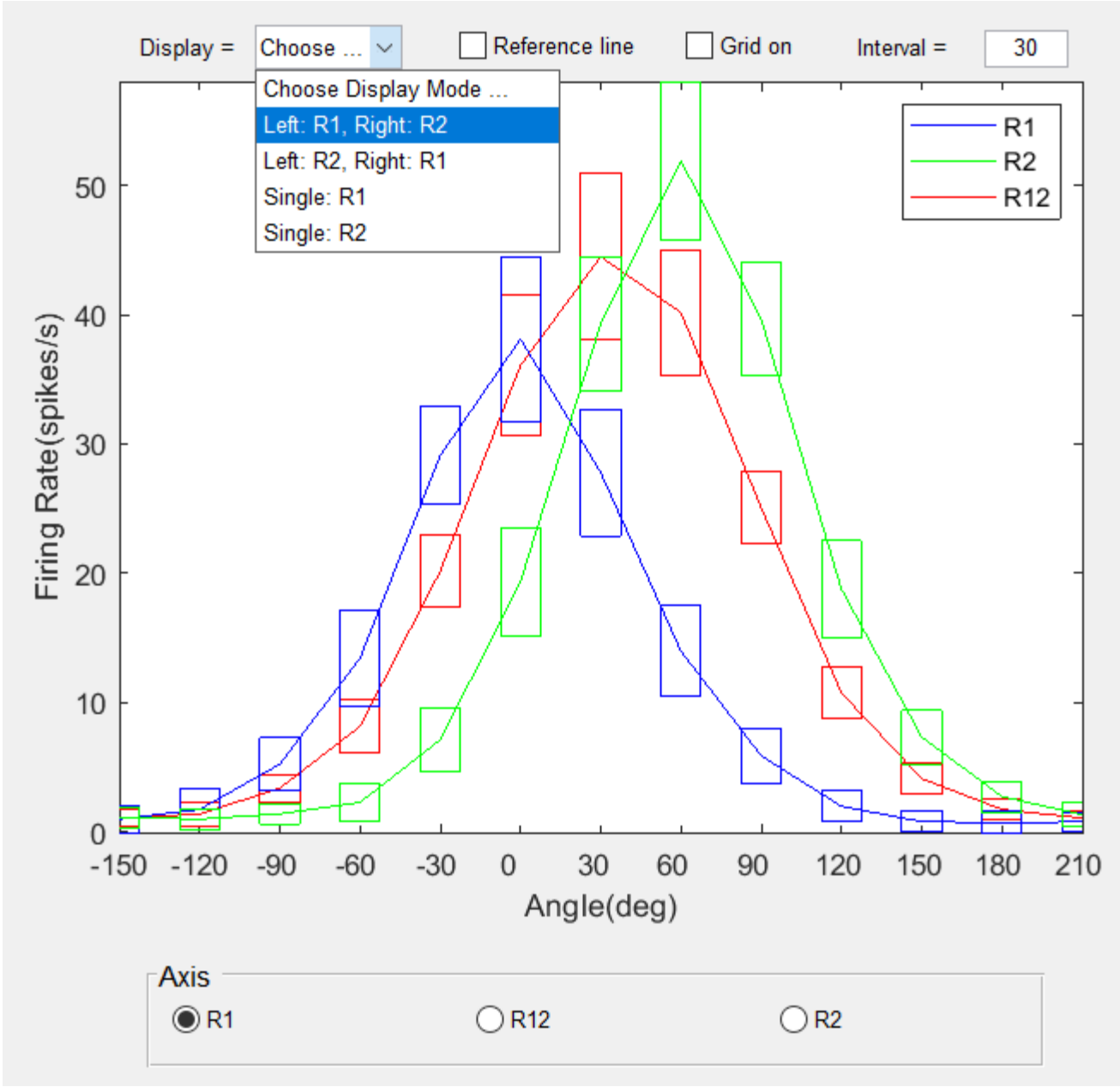
$$ff_1 = \sigma_1^2 / \mu_1$$

$$ff_2 = \sigma_2^2 / \mu_2$$



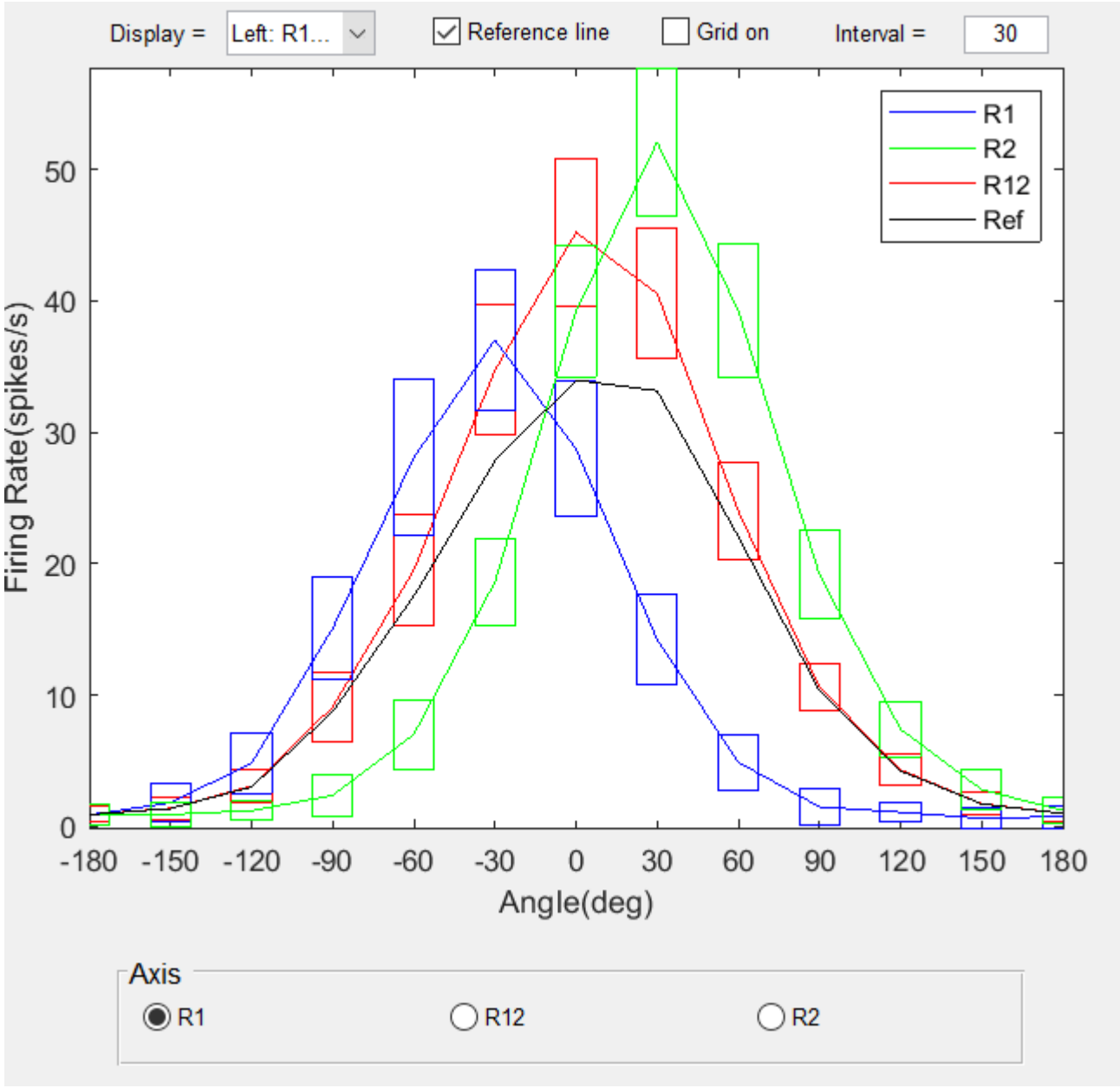
Step 2: Plot the figure

- **Display Mode**
- Change the display mode.
- Left R1 right R2 (Default)
- Left R2 right R1
- Single R1
- Single R2



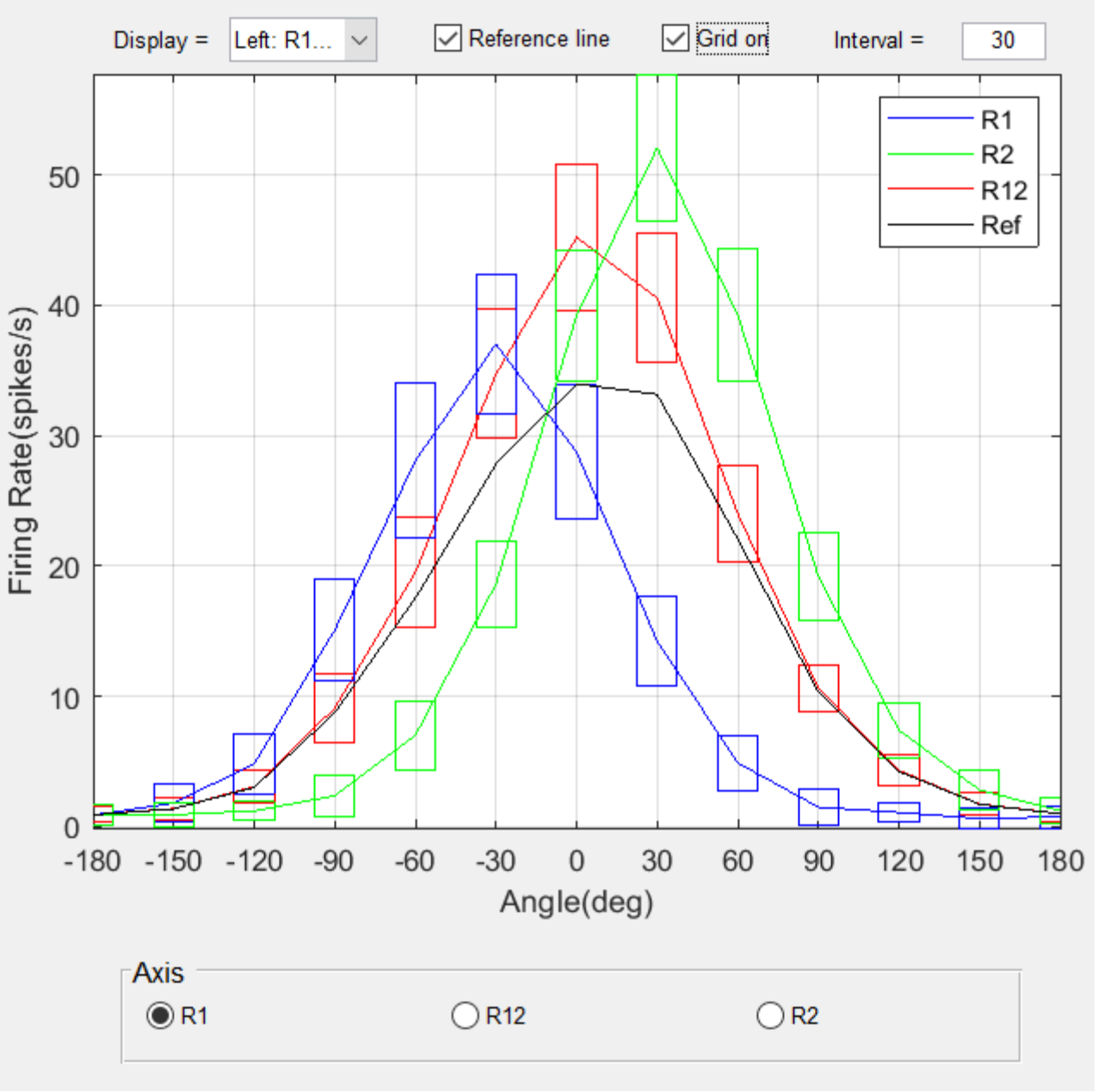
Step 2: Plot the figure

- **Reference line**
- Always plot the R_{12} whose w_1 and w_2 are all set to 0.5 and b equals zero to show the reference.



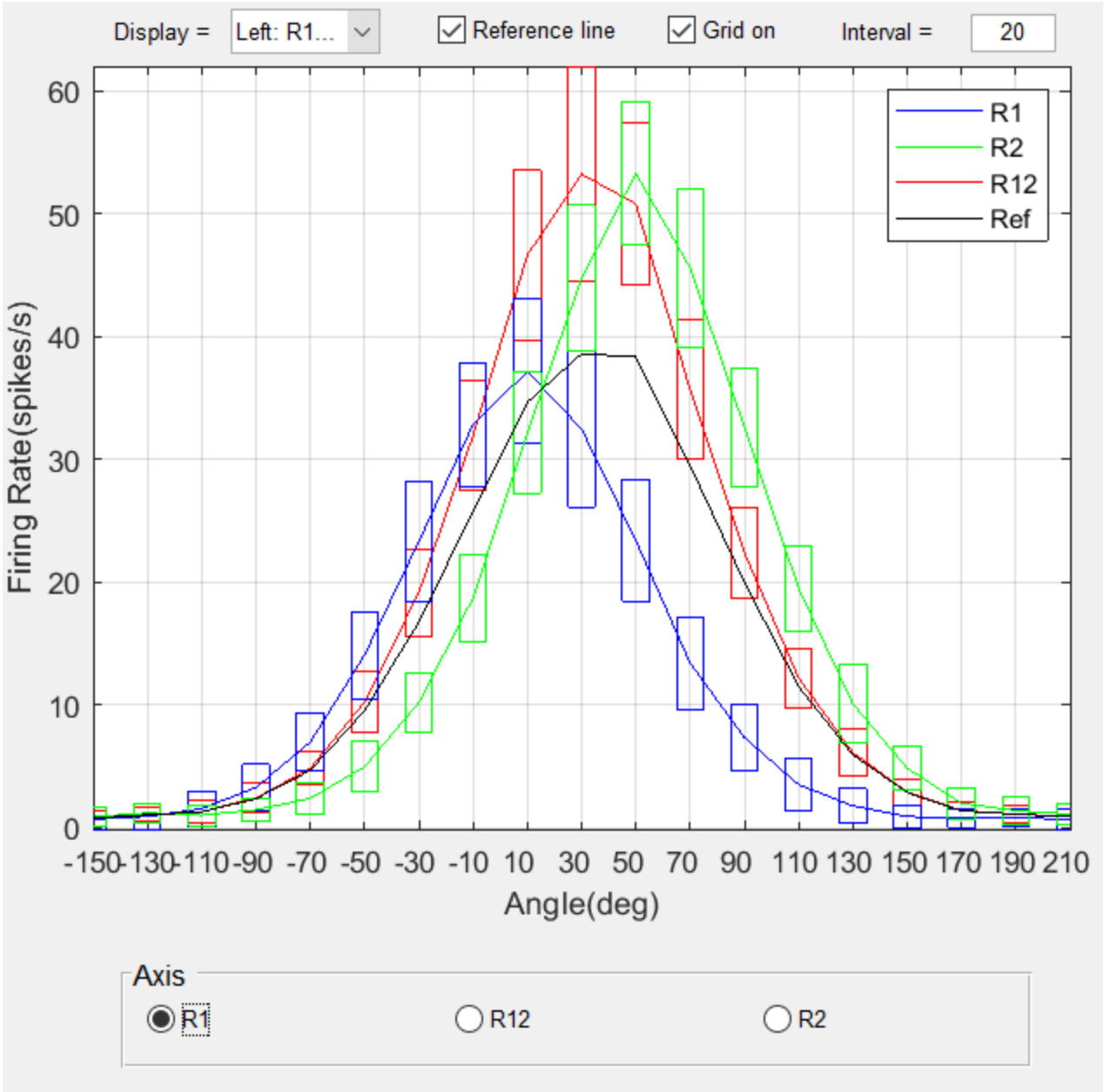
Step 2: Plot the figure

- **Grid on**
- Check the box to put on grid;
- Deselect the box to put the grid off.



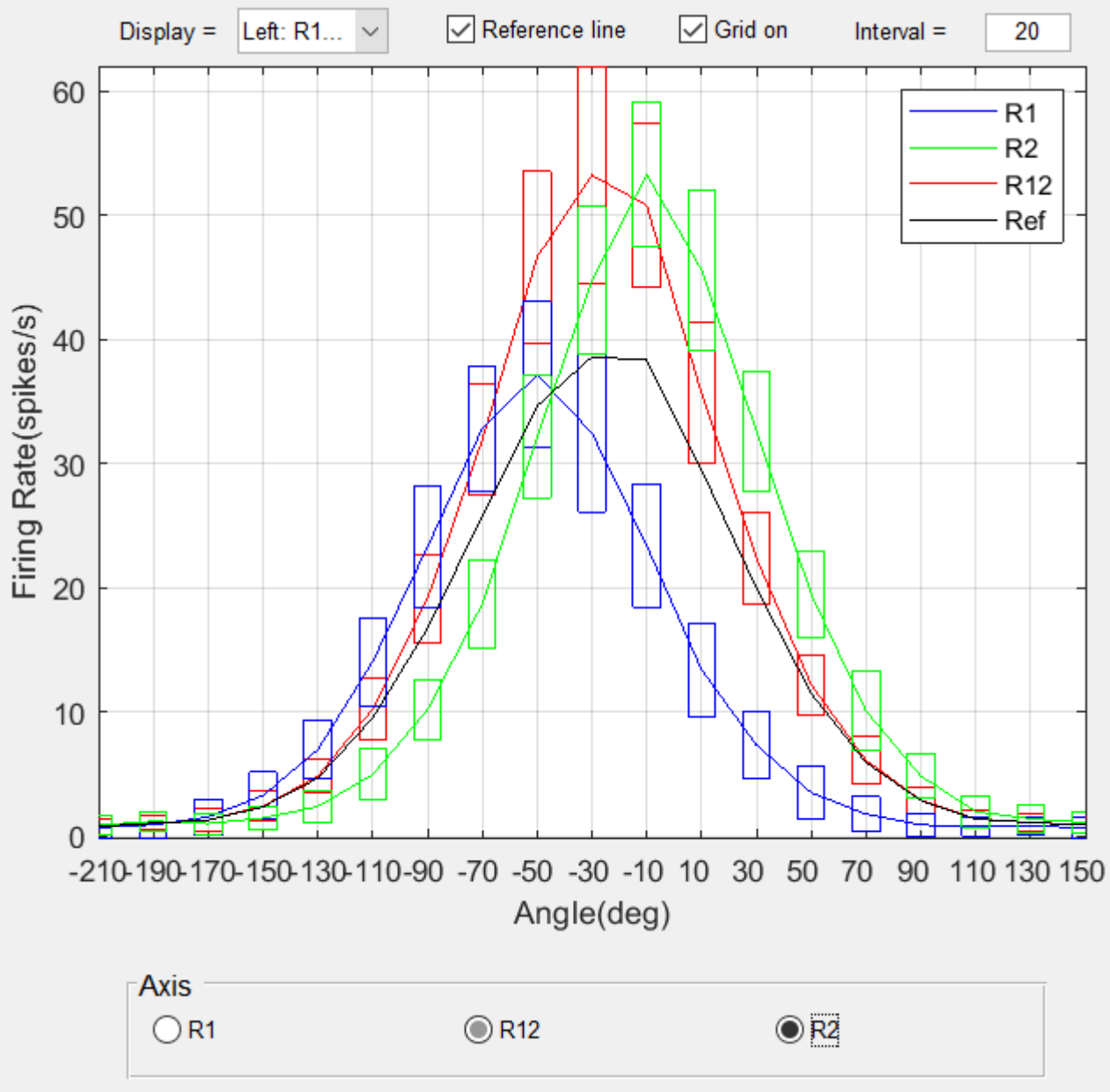
Step 2: Plot the figure

- **Interval**
- Change the interval to make the points densier.



Step 2: Plot the figure

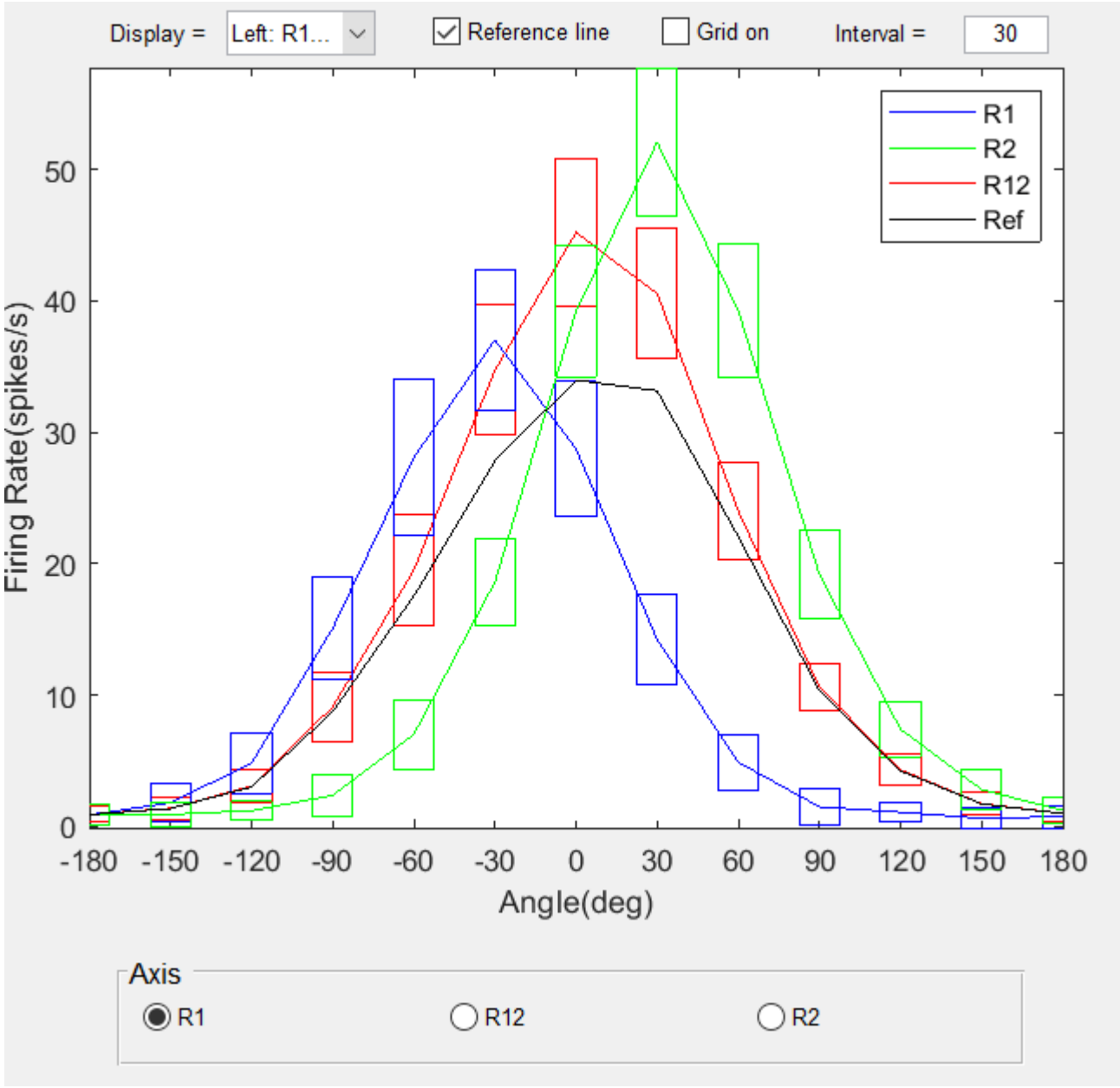
- **Axis**
- Select the axis of different firing rate.
- R1 is always the blue one and R2 the green.
- R12 is the red curve.



Step 2: Plot the figure

- **Press this button to plot**

von Mises function



Step 3: Show the results

- **Results**
- Peak Value: the maximum values.
- STD deviation: standard deviation
- Separation: angle between θ1(θ2) and the average of θ1 and θ2. Note that the separation of R12 means the angle between θ1 and θ2
- Bandwidth: threshold = 1/2 * max

Results and Verification

	R1	R2	R12
Peak value	37.3612	51.4645	56.9505
STD deviation	2.7228	2.8006	2.9041
Separation	-30	30	0
Bandwidth	80	80	80
Verify(Gaussian)	0	0	0

	w1	w2	b
Setting mean	0.5000	0.5000	0.0100
Fitting mean	0.4694	0.4845	0.0120
Setting var(std)	0.0300	0.0100	0.0050
Fitting var(std)	0.0268	0.0100	0.0046
Verify(Gaussian)	0	0	0

Show Results

Step 3: Show the results

- **Results: Verify**
- Fitting mean value and varience (std) of w1, w2, b.
- Comparison of original settings.
- 0 means that the rates or parameters are conform to Gaussian Distribution, 1 means not.

Results and Verification

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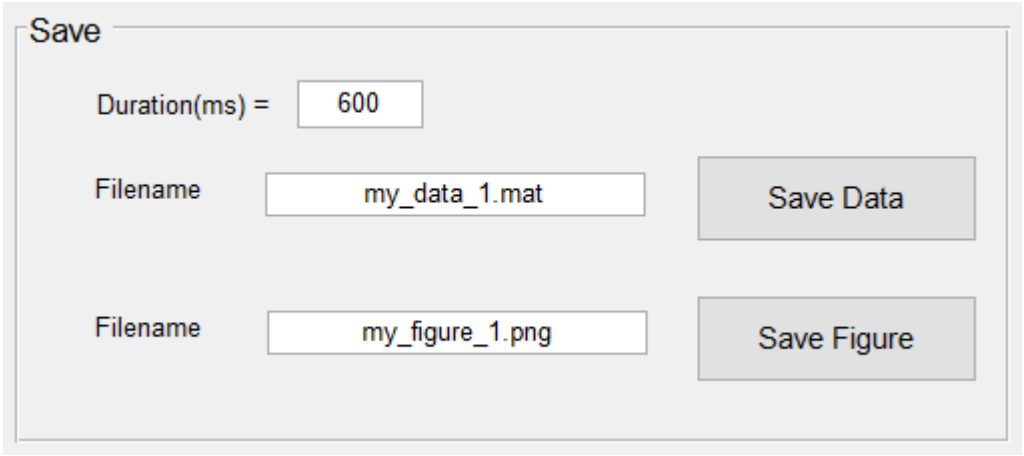
Fitting var(std)	0.0268	0.0100	0.0046
Verify(Gaussian)	0	0	0

Show Results

Step 4: Save

- **Save the data**
- Type the file name and save as a struct in a MATLAB document.
- Duration is used to calculate the spikes number in the time period.



- **Save the figure**
- Type the file name and save as picture in a MATLAB document.
- Currently it supports only PNG, but other image formats will be added

Thank you!