June18

June 18, 2020

1 Reviews

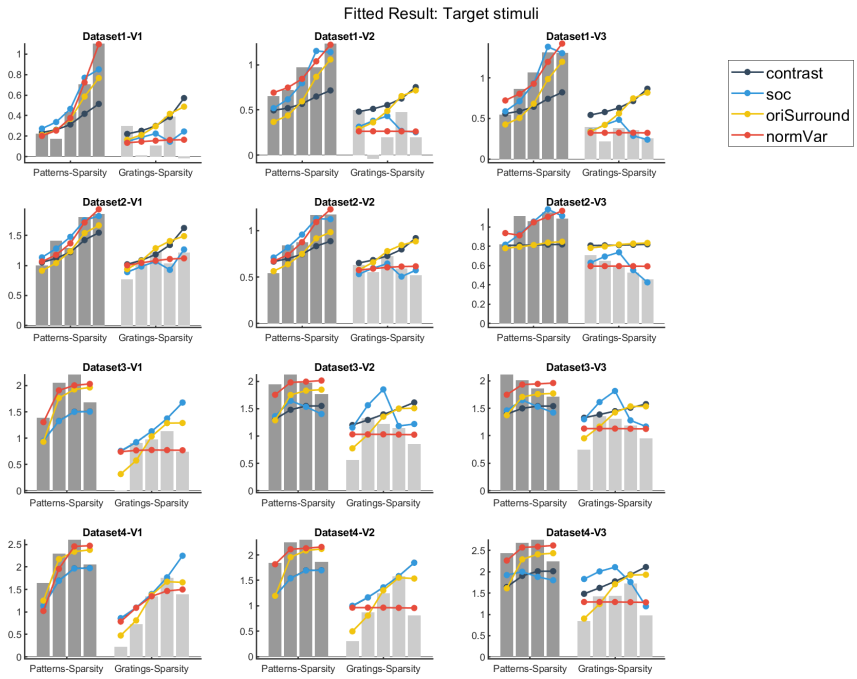
1.1 Questions:

We shows some images trying to interpret the fit results. Mainly, we answered the following answer:

- Why SOC model fit the target dataset1, dataset2 well, but bad at dataset3, 4 and whole dataset.
- Why we get some weird paramters?

1.2 Answers:

- The s of SOC in dataset3 and dataset4 statisfy the following two conditions:
  1. all s of patten stimuli is larger than gratings stimuli
  2. the curve along with the sparsity in partterns is steeper than that of gratings To fit the BOLD in dataset1,2, the SOC model requires the n to be large or even $n > 1$
-



	Dataset 1			Dataset 2			Dataset 3			Dataset 4		
	V1	V2	V3	V1	V2	V3	V1	V2	V3	V1	V2	V3
Contrast												
g	68.4	1.289	1.641	3.083	1.469	0.839	2.46	1.856	1.710	3.56	2.482	2.498
n	1.54	0.242	0.253	0.253	0.186	0.008	0.294	0.105	0.063	0.355	0.227	0.130
SOC												
c	1.119	1.219	1.941	2.033	1.123	1.237	1.484 e+05	1.356	1.409	1.708 e+06	1.77e 06	1.640
g	2.96e +06	6156	1571 0	121.5	163.9	109.6	0.079 5	26.15	11.98	0.024	0.099	4.786
n	2.41	1.360	1.478	0.680	0.790	0.710	0.147	0.561	0.399	0.177	0.113	0.172
Ori Surround												
w	45.6	103.8	101.1	82.67	100.4	82.70	75.61	67.33	77.11	98.32	107.9	67.78
g	64.7	99.98	99.99	25.15	13.88	1.228	99.91	11.38	6.782	100	66.68	19.51
n	0.998	0.890	0.870	0.556	0.524	0.076	0.855	0.405	0.291	0.772	0.700	0.463
NormVar												
w	102.8	861.7	433.4	81.86	112.5	633	114.9	5.e05	2.4e0 6	16.82	867.1 2	1.3e0 6
g	66.68	85.95	51.20	7.270	5.611	6.869	8.929	271.2	88.15	6.882	17.03	274.2
n	0.678	0.446	0.437	0.226	0.248	0.198	0.274	0.184	0.151	0.296	0.222	0.194

1.3 Proposed solution:

Add contrast group to the target stimuli, because contrast group require $n < 1$.

2 Models

$I(x,y) \overset{\text{Pyr(x,y)}}{\rightarrow} C(x,y,\theta,\phi) \overset{\sum_\phi\{\}^2}{\rightarrow} E(x,y,\theta) \overset{\text{normalization}}{\rightarrow} s \overset{g\{\}^n}{\rightarrow}$ BOLD Pred

The following models differ from each other at the normalization step:

- contrast:

  $s = \sum_{x,y,\theta} E(x,y,\theta)$

- normVar:

  $E_{\text{tot}}(\theta) = \sum_{x,y} E(x,y,\theta),\ s = \sum_\theta \frac{E^2_{\text{tot}}(\theta)}{1+w^2 * Var(E_{\text{tot}}(\theta))}$

- soc:

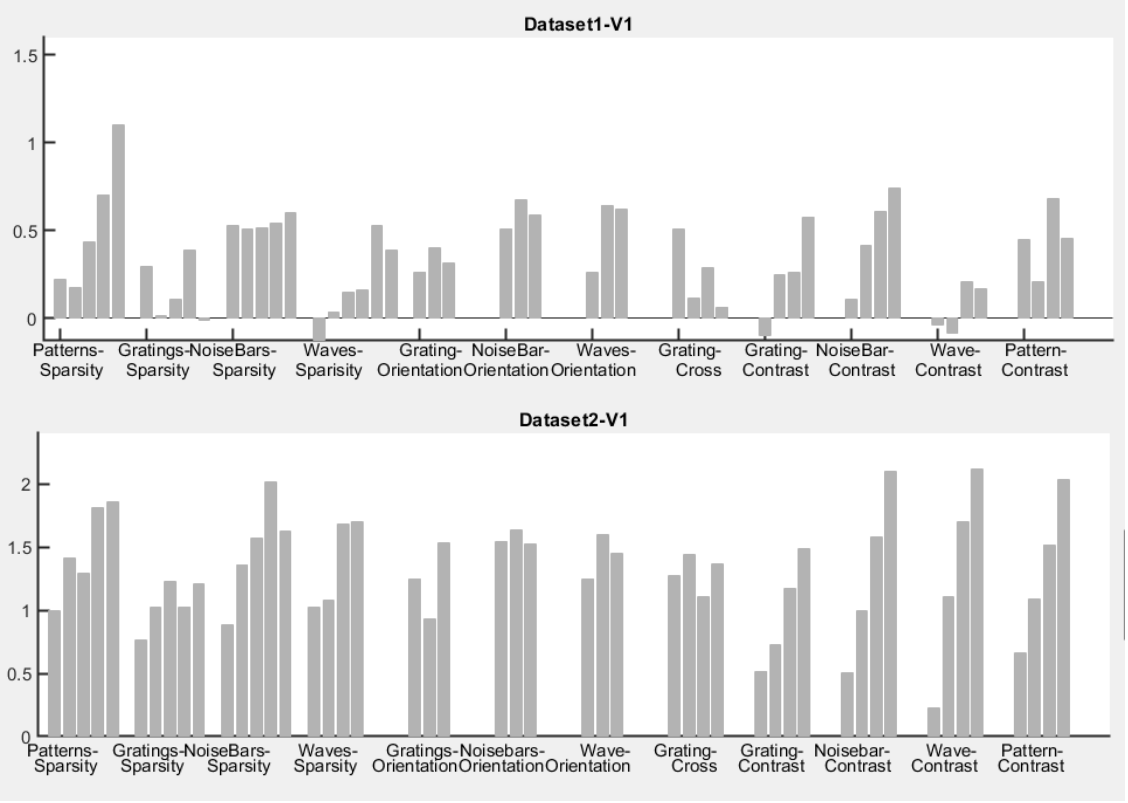
  $E_{xy}(x,y) = \sum_\theta E(x,y,\theta)\ \bar{E}_{xy} = \frac{1}{nx \times ny} \sum_{x,y} E_{xy}(x,y)\ s = \sum_{x,y} (E_{xy}(x,y) - c * \bar{E}_{xy})^2$

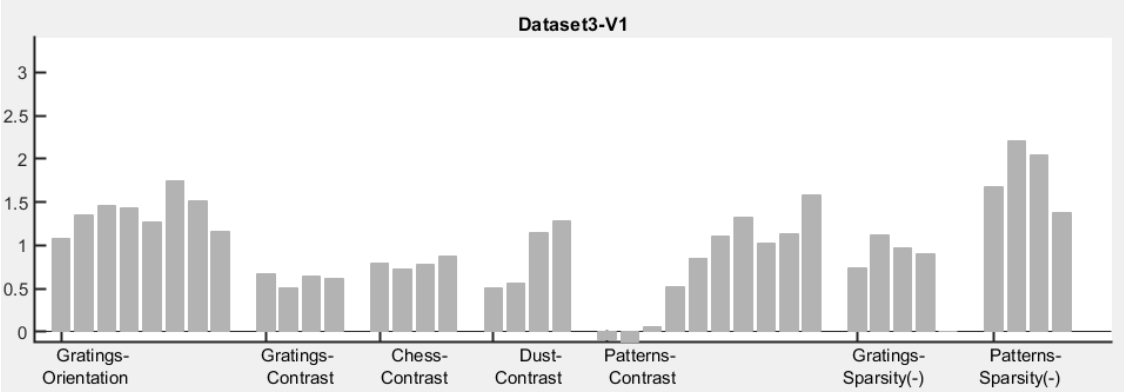
- ori surround:

  $s = \sum_{x,y,\theta} \frac{E(x,y,\theta)}{1+w * \sum_{x',y',\theta'} F(x-x',y-y',\theta-\theta') \cdot E(x,y,\theta)}$

3 Choose data

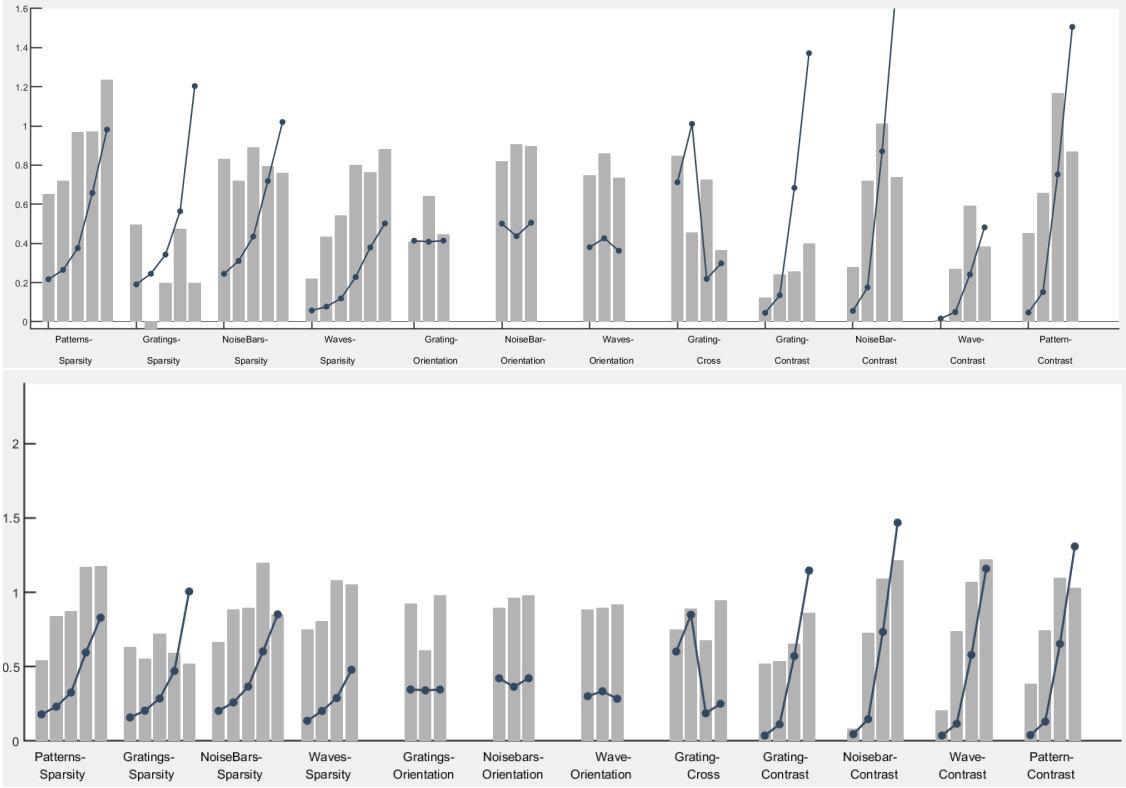
3.1 Examples of stimuli

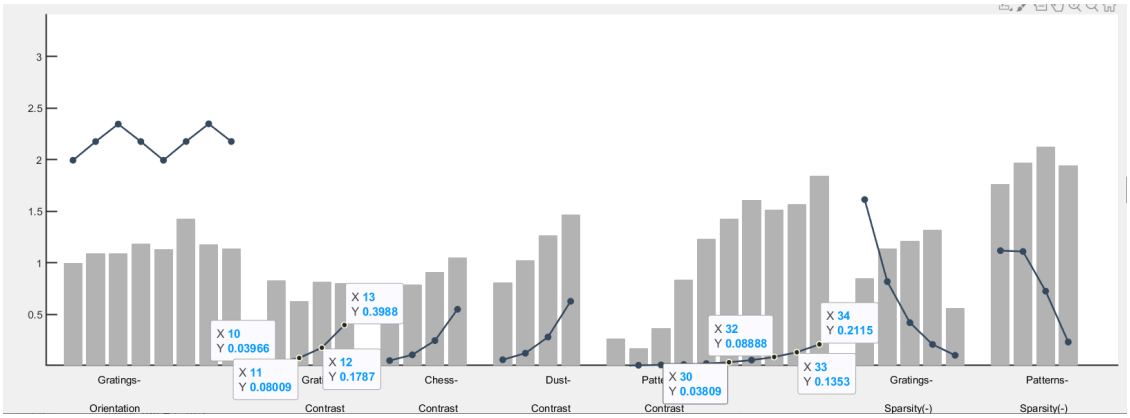




3.2 Energy of stimuli

We need to choose image of which the energy value match.

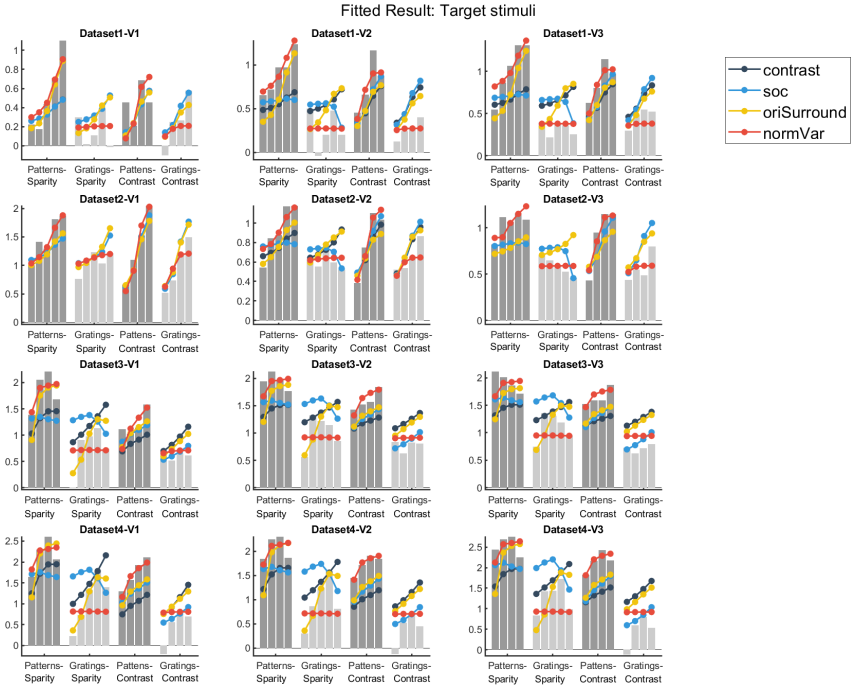




3.3 Fit details

- init range of params are: [exp(-5), exp(8)]
- no bound using fmincon
- 40 random init points.

3.4 Fit Target



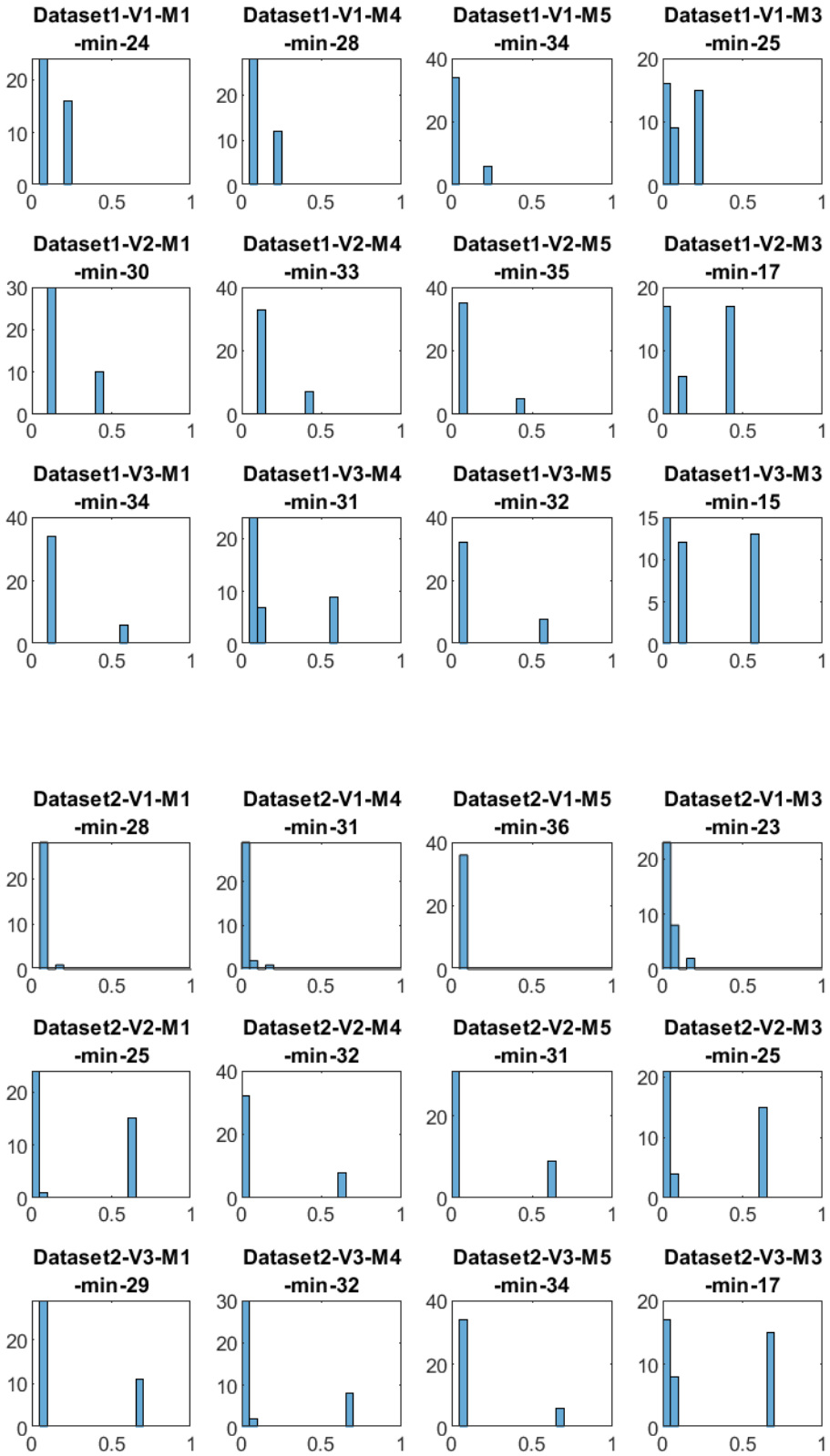
R^2 table target

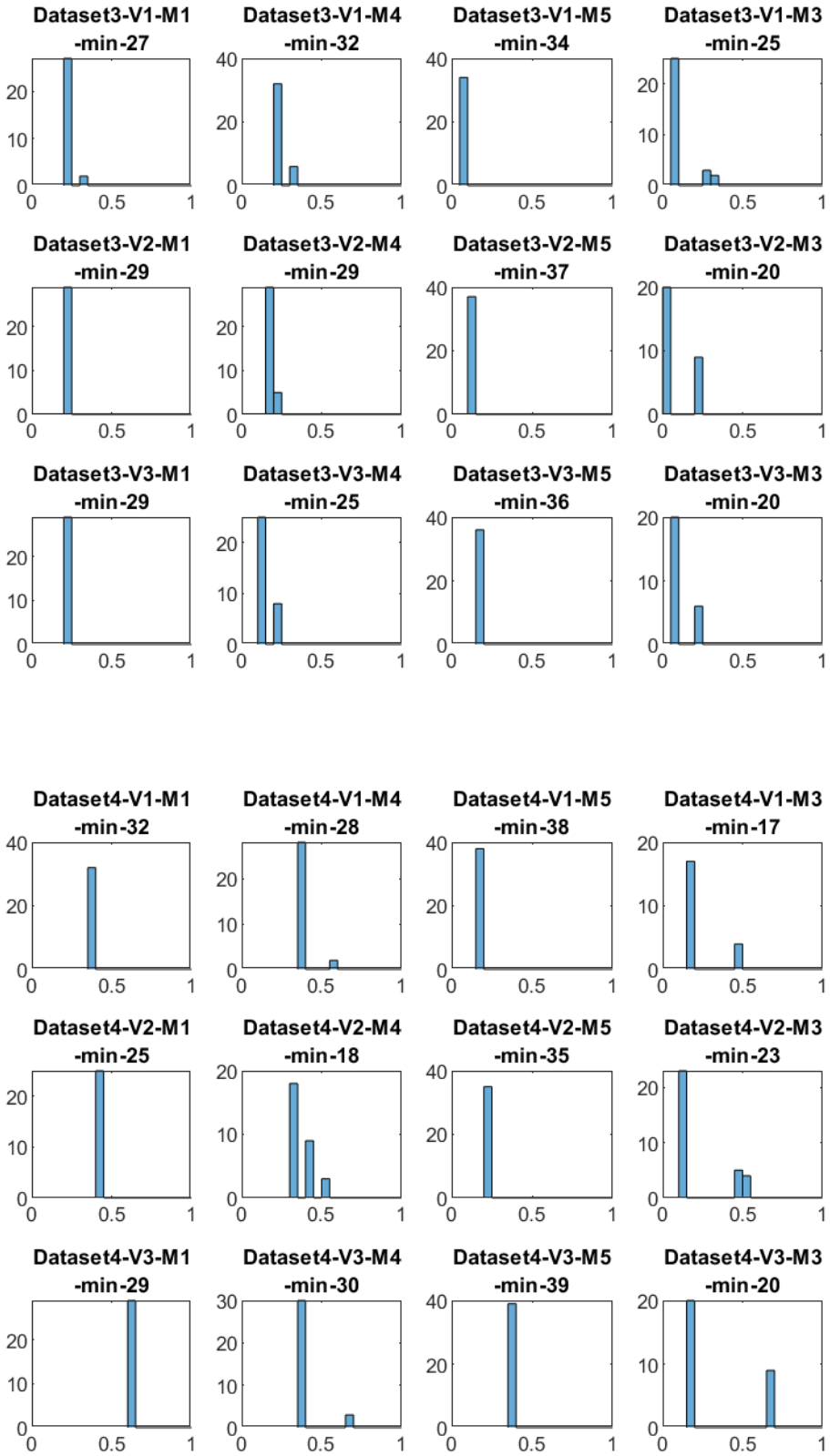
	Dataset 1			Dataset 2			Dataset 3			Dataset 4		
	V1	V2	V3	V1	V2	V3	V1	V2	V3	V1	V2	V3
contrast	.220	.129	.111	.692	.404	.184	.239	.092	.076	.340	.168	.123
SOC	.218	.206	.208	.708	.464	.403	.248	.360	.446	.360	.386	.468
OriSurround	.553	.402	.436	.691	.455	.184	.707	.437	.337	**.714**	.562	.432
normVar	**.587**	**.854**	**.890**	**.861**	**.841**	**.854**	**.768**	**.818**	**.767**	.672	**.746**	**.762**

Rmse table target

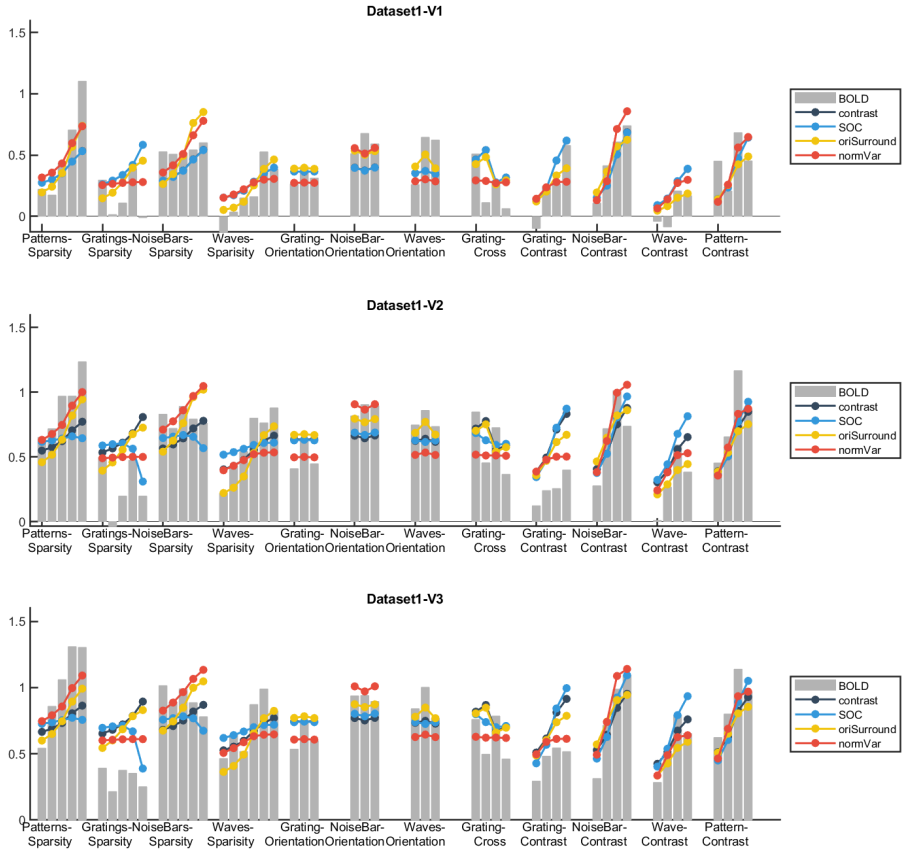
	Dataset 1			Dataset 2			Dataset 3			Dataset 4		
	V1	V2	V3	V1	V2	V3	V1	V2	V3	V1	V2	V3
contrast	.253	.337	.330	.228	.183	.246	.480	.470	.466	.612	.647	.777
SOC	.253	.322	.311	.222	.173	.210	.476	.394	.361	.602	.555	.605
OriSurround	.192	.280	.263	.228	.175	.246	.297	.370	.395	**.403**	.470	.626
normVar	**.184**	**.138**	**.116**	**.153**	**.094**	**.104**	**.265**	**.210**	**.234**	.431	**.357**	**.404**

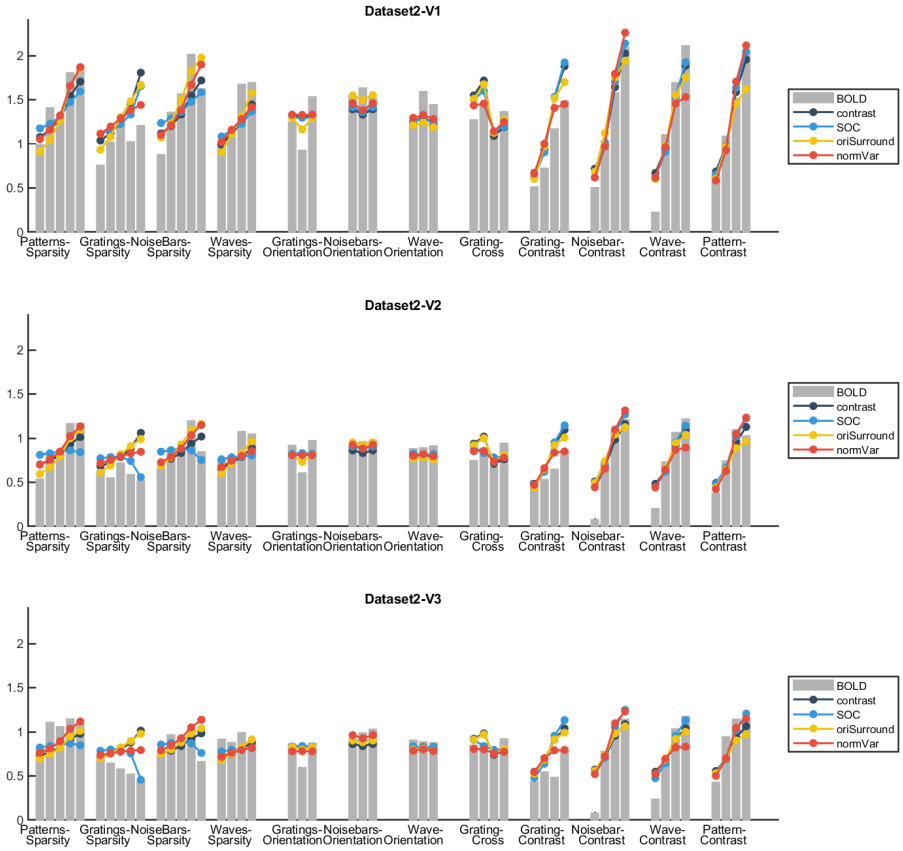
	Dataset 1			Dataset 2			Dataset 3			Dataset 4		
	V1	V2	V3	V1	V2	V3	V1	V2	V3	V1	V2	V3
Contrast												
g	1.471	1.288	1.264	3.422	1.553	1.326	2.098	1.784	1.746	3.118	2.296	2.560
n	0.407	0.229	0.173	0.289	0.202	0.144	0.220	0.099	0.087	0.283	0.196	0.157
SOC												
c	51197	1.587	1.587	0.00958	1.439	1.514	1.644	1.642	1.641	1.619	1.636	1.637
g	0.0193	1.469	1.490	3.116	1.626	1.637	2.116	2.351	2.490	3.085	3.040	3.933
n	0.203	0.136	0.111	0.158	0.110	0.103	0.090	0.077	0.083	0.112	0.117	0.122
Ori Surround												
w	51.21	128.9	192.4	0.000435	48.72	0.000392	125.9	144.3	142.1	113.8	157.5	177.1
g	244.7	244.7	244.1	3.422	8.214	1.328	244.7	36.43	21.59	244.7	244.7	244.7
n	1.242	1.017	0.933	0.289	0.472	0.144	0.951	0.569	0.477	0.924	0.892	0.842
NormVar												
w	151.5	679.8	676.5	63.37	134.6	337.2	217.7	543.1	773.1	404.8	785.9	857.3
g	21.63	75.61	39.91	6.375	4.113	6.790	12.48	11.78	11.59	22.68	35.20	37.91
n	0.489	0.450	0.373	0.214	0.200	0.220	0.280	0.212	0.196	0.290	0.305	0.286

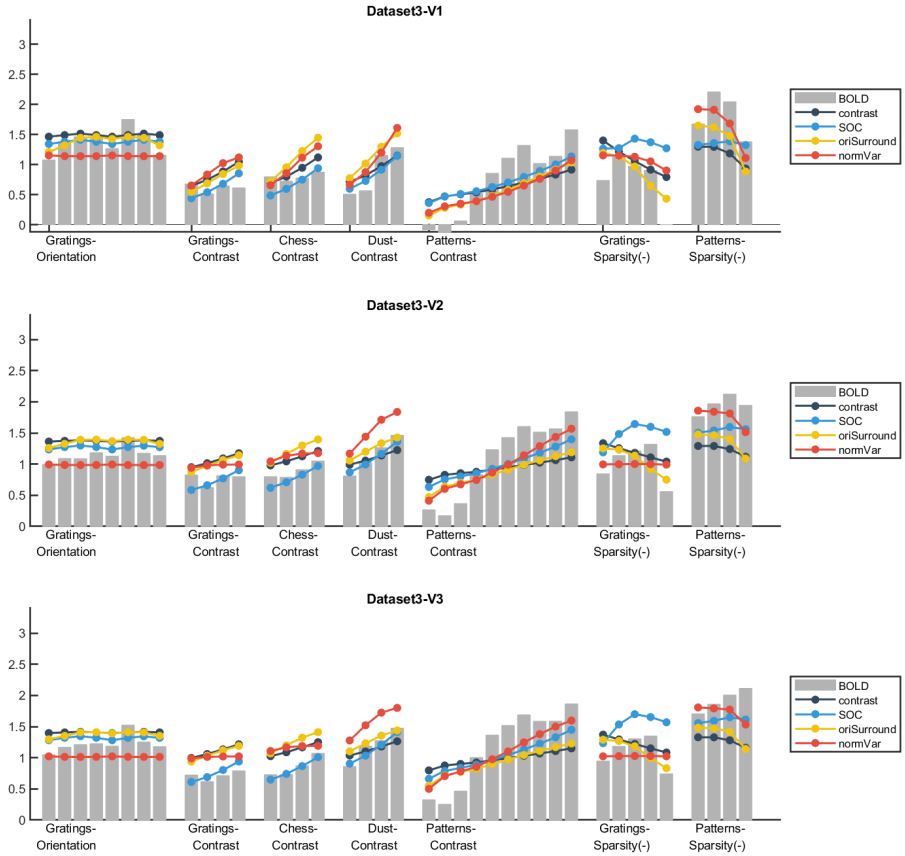

Dataset1-V1-M1
-min-24
Dataset1-V1-M4
-min-28
Dataset1-V1-M5
-min-34
Dataset1-V1-M3
-min-25
Dataset1-V2-M1
-min-30
Dataset1-V2-M4
-min-33
Dataset1-V2-M5
-min-35
Dataset1-V2-M3
-min-17
Dataset1-V3-M1
-min-34
Dataset1-V3-M4
-min-31
Dataset1-V3-M5
-min-32
Dataset1-V3-M3
-min-15
Dataset2-V1-M1
-min-28
Dataset2-V1-M4
-min-31
Dataset2-V1-M5
-min-36
Dataset2-V1-M3
-min-23
Dataset2-V2-M1
-min-25
Dataset2-V2-M4
-min-32
Dataset2-V2-M5
-min-31
Dataset2-V2-M3
-min-25
Dataset2-V3-M1
-min-29
Dataset2-V3-M4
-min-32
Dataset2-V3-M5
-min-34
Dataset2-V3-M3
-min-17

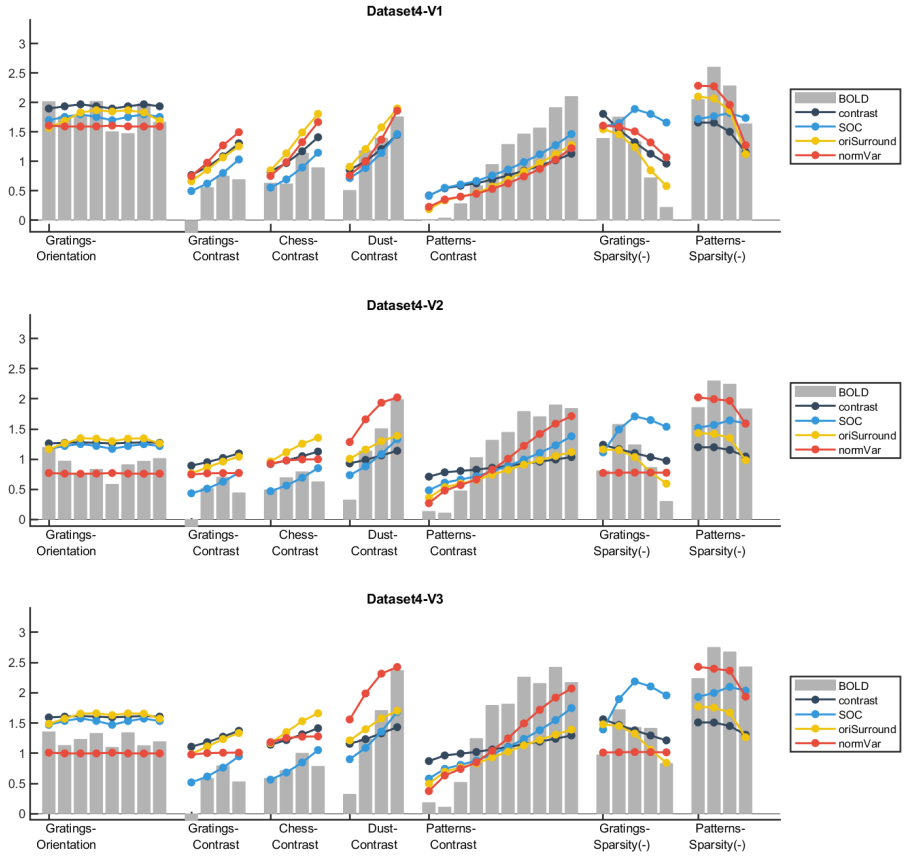

Dataset3-V1-M1
-min-27
Dataset3-V1-M4
-min-32
Dataset3-V1-M5
-min-34
Dataset3-V1-M3
-min-25
Dataset3-V2-M1
-min-29
Dataset3-V2-M4
-min-29
Dataset3-V2-M5
-min-37
Dataset3-V2-M3
-min-20
Dataset3-V3-M1
-min-29
Dataset3-V3-M4
-min-25
Dataset3-V3-M5
-min-36
Dataset3-V3-M3
-min-20
Dataset4-V1-M1
-min-32
Dataset4-V1-M4
-min-28
Dataset4-V1-M5
-min-38
Dataset4-V1-M3
-min-17
Dataset4-V2-M1
-min-25
Dataset4-V2-M4
-min-18
Dataset4-V2-M5
-min-35
Dataset4-V2-M3
-min-23
Dataset4-V3-M1
-min-29
Dataset4-V3-M4
-min-30
Dataset4-V3-M5
-min-39
Dataset4-V3-M3
-min-20

3.5 Fit All


Dataset1-V1
Dataset1-V2
Dataset1-V3
1.5
1
0.5
0
BOLD
contrast
SOC
oriSurround
normVar
Patterns-Sparsity
Gratings-Sparsity
NoiseBars-Sparsity
Waves-Sparisity
Grating-Orientation
NoiseBar-Orientation
Waves-Orientation
Grating-Cross
Grating-Contrast
NoiseBar-Contrast
Wave-Contrast
Pattern-Contrast


Dataset2-V1
Dataset2-V2
Dataset2-V3
BOLD
contrast
SOC
oriSurround
normVar
0
0.5
1
1.5
2
Patterns-Sparsity
Gratings-Sparsity
NoiseBars-Sparsity
Waves-Sparsity
Gratings-Orientation
Noisebars-Orientation
Wave-Orientation
Grating-Cross
Grating-Contrast
Noisebar-Contrast
Wave-Contrast
Pattern-Contrast


Dataset3-V1
Dataset3-V2
Dataset3-V3
BOLD
contrast
SOC
oriSurround
normVar
Gratings-Orientation
Gratings-Contrast
Chess-Contrast
Dust-Contrast
Patterns-Contrast
Gratings-Sparsity(-)
Patterns-Sparsity(-)


Dataset4-V1
Dataset4-V2
Dataset4-V3
BOLD
contrast
SOC
oriSurround
normVar
Gratings-Orientation
Gratings-Contrast
Chess-Contrast
Dust-Contrast
Patterns-Contrast
Gratings-Sparsity(-)
Patterns-Sparsity(-)

```
-------------------------------------V1-------------------------------

r2_table =

  4×5 table

        model          dataset1    dataset2    dataset3    dataset4
    ________________    ________    ________    ________    ________

    {'contrast'  }      0.34499      0.6745     0.45943     0.51265
    {'soc'       }      0.34117     0.67994     0.48301     0.56884
    {'oriSurrond'}      0.57469     0.73176     0.61935     0.62233
    {'normVar'   }      0.55424     0.73156     0.55973      0.5454

-------------------------------------V2-------------------------------

r2_table =

  4×5 table

        model          dataset1    dataset2    dataset3    dataset4
    ________________    ________    ________    ________    ________

    {'contrast'  }      0.23237     0.49324     0.18071     0.081495
    {'soc'       }      0.26157      0.5431     0.48769      0.41124
    {'oriSurrond'}      0.42408     0.57233     0.33812      0.21678
    {'normVar'   }       0.5407     0.61378     0.60462      0.60911

-------------------------------------V3-------------------------------

r2_table =

  4×5 table

        model          dataset1    dataset2    dataset3    dataset4
    ________________    ________    ________    ________    ________

    {'contrast'  }      0.20371     0.32828     0.17265     0.09663
    {'soc'       }      0.31306     0.53055     0.54298     0.49439
    {'oriSurrond'}      0.34712      0.3406     0.29109     0.20406
    {'normVar'   }      0.55874     0.48178     0.53114     0.55641
```

```
-------------------------------------V1-------------------------------

rmse_table =

  4×5 table

        model          dataset1    dataset2    dataset3    dataset4
    ________________    ________    ________    ________    ________

    {'contrast'  }      0.20844     0.23993     0.39165     0.48168
    {'soc'       }      0.20904     0.23792     0.38301     0.45306
    {'oriSurrond'}      0.16796     0.21781     0.32864     0.42403
    {'normVar'   }      0.17195     0.21789     0.35345     0.46521

-------------------------------------V2-------------------------------

rmse_table =

  4×5 table

        model          dataset1    dataset2    dataset3    dataset4
    ________________    ________    ________    ________    ________

    {'contrast'  }      0.25632      0.1778      0.4072     0.58877
    {'soc'       }       0.2514     0.16882       0.322     0.47138
    {'oriSurrond'}      0.22202     0.16333       0.366     0.54368
    {'normVar'   }      0.19827     0.15522     0.28288     0.38409

-------------------------------------V3-------------------------------

rmse_table =

  4×5 table

        model          dataset1    dataset2    dataset3    dataset4
    ________________    ________    ________    ________    ________

    {'contrast'  }      0.24305     0.20134     0.40312     0.69846
    {'soc'       }      0.22574     0.16832     0.29961     0.52254
    {'oriSurrond'}      0.22007     0.19948     0.37315     0.65562
    {'normVar'   }      0.18092     0.17684     0.30347     0.48944
```

----------V1----------

param_table =

11×9 table

model	dataset1: mean	dataset1: sem	dataset2: mean	dataset2: sem	dataset3: mean	dataset3: sem	dataset4: mean	dataset4: sem
{'contrastModel: g' }	1.7621	NaN	3.857	NaN	1.8371	NaN	2.4403	NaN
{'contrastModel: n' }	0.43781	NaN	0.30066	NaN	0.20906	NaN	0.23119	NaN
{'socModel: c' }	1.35e+05	NaN	1.9243e-08	NaN	1.3764	NaN	1.4087	NaN
{'socModel: g' }	0.010783	NaN	3.4394	NaN	2.7748	NaN	3.93	NaN
{'socModel: n' }	0.21938	NaN	0.16245	NaN	0.14019	NaN	0.15467	NaN
{'oriSurroundModel: w'}	72.496	NaN	28.266	NaN	23.687	NaN	15.963	NaN
{'oriSurroundModel: g'}	133.01	NaN	19.198	NaN	13.183	NaN	12.556	NaN
{'oriSurroundModel: n'}	1.0811	NaN	0.57769	NaN	0.58375	NaN	0.55095	NaN
{'normVarModel: w' }	117.08	NaN	38.861	NaN	30.209	NaN	17.87	NaN
{'normVarModel: g' }	6.1743	NaN	5.5408	NaN	4.0127	NaN	4.5304	NaN
{'normVarModel: n' }	0.34409	NaN	0.1964	NaN	0.19815	NaN	0.19682	NaN

----------V2----------

param_table =

11×9 table

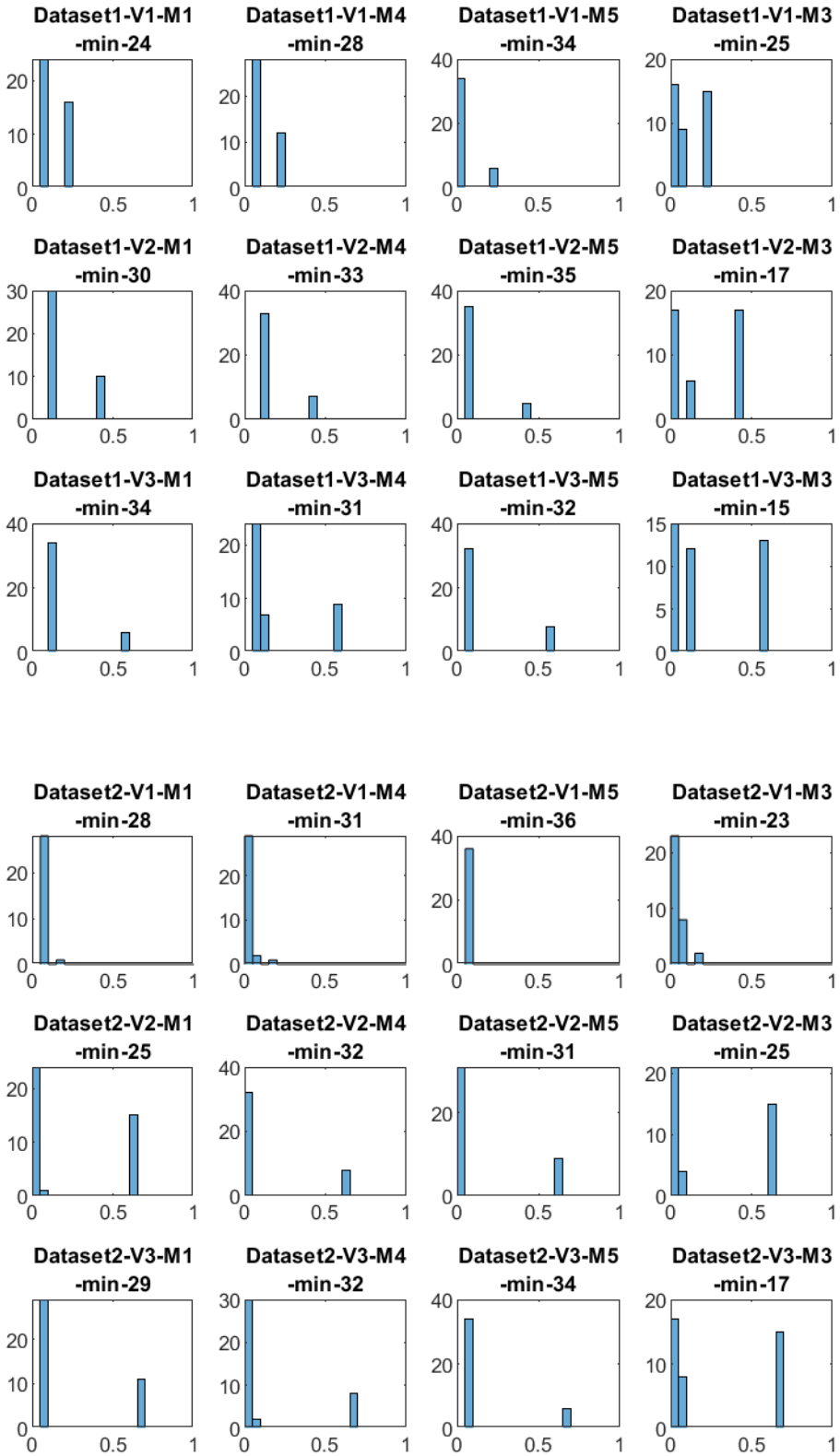
model	dataset1: mean	dataset1: sem	dataset2: mean	dataset2: sem	dataset3: mean	dataset3: sem	dataset4: mean	dataset4: sem
{'contrastModel: g' }	1.4245	NaN	1.934	NaN	1.5047	NaN	1.3877	NaN
{'contrastModel: n' }	0.22432	NaN	0.23858	NaN	0.091735	NaN	0.088276	NaN
{'socModel: c' }	1.5863	NaN	1.4184	NaN	1.6475	NaN	1.6435	NaN
{'socModel: g' }	1.542	NaN	2.0167	NaN	2.6132	NaN	3.1619	NaN
{'socModel: n' }	0.13237	NaN	0.13184	NaN	0.097585	NaN	0.12938	NaN
{'oriSurroundModel: w'}	75.847	NaN	38.533	NaN	33.123	NaN	51.196	NaN
{'oriSurroundModel: g'}	16.127	NaN	9.8137	NaN	4.6916	NaN	7.9134	NaN
{'oriSurroundModel: n'}	0.58601	NaN	0.51349	NaN	0.30062	NaN	0.40334	NaN
{'normVarModel: w' }	191.24	NaN	50.108	NaN	200.89	NaN	351.75	NaN
{'normVarModel: g' }	4.4509	NaN	2.9112	NaN	5.6148	NaN	14.76	NaN
{'normVarModel: n' }	0.21917	NaN	0.16842	NaN	0.1717	NaN	0.26373	NaN

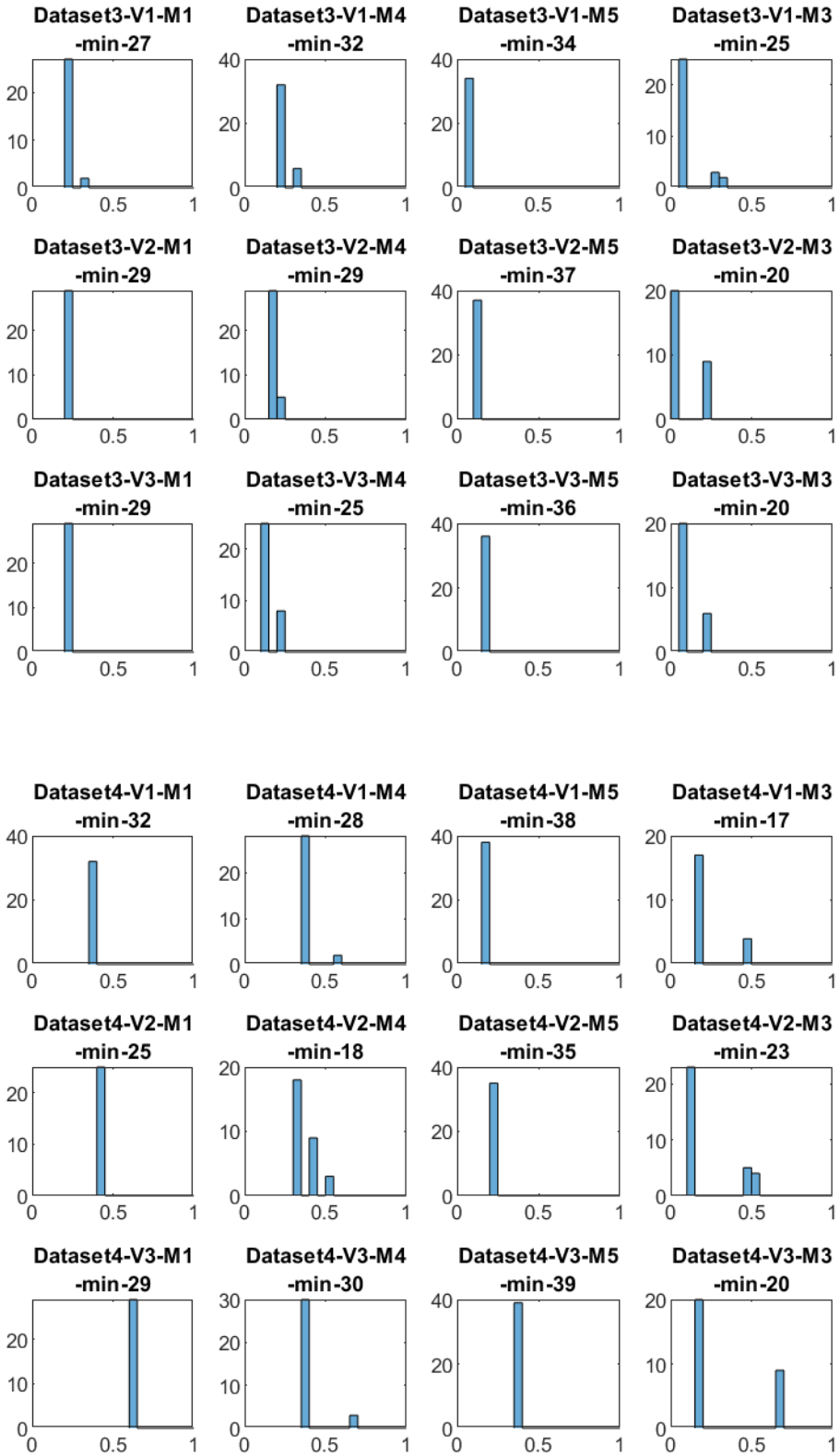
----------V3----------

param_table =

11×9 table

model	dataset1: mean	dataset1: sem	dataset2: mean	dataset2: sem	dataset3: mean	dataset3: sem	dataset4: mean	dataset4: sem
{'contrastModel: g' }	1.3777	NaN	1.6214	NaN	1.5333	NaN	1.7627	NaN
{'contrastModel: n' }	0.17069	NaN	0.18649	NaN	0.08601	NaN	0.092493	NaN
{'socModel: c' }	1.5869	NaN	1.4944	NaN	1.6444	NaN	1.6432	NaN
{'socModel: g' }	1.6693	NaN	1.9191	NaN	2.685	NaN	4.1644	NaN
{'socModel: n' }	0.11995	NaN	0.12258	NaN	0.096328	NaN	0.1354	NaN
{'oriSurroundModel: w'}	51.107	NaN	12.51	NaN	29.897	NaN	30.631	NaN
{'oriSurroundModel: g'}	5.8475	NaN	2.7236	NaN	3.8637	NaN	6.1306	NaN
{'oriSurroundModel: n'}	0.39205	NaN	0.27969	NaN	0.25473	NaN	0.32843	NaN
{'normVarModel: w' }	196.75	NaN	79.352	NaN	262.05	NaN	325.69	NaN
{'normVarModel: g' }	3.8093	NaN	2.5717	NaN	5.3407	NaN	14.186	NaN
{'normVarModel: n' }	0.18236	NaN	0.14297	NaN	0.15577	NaN	0.23903	NaN


Dataset1-V1-M1
-min-24
Dataset1-V1-M4
-min-28
Dataset1-V1-M5
-min-34
Dataset1-V1-M3
-min-25
Dataset1-V2-M1
-min-30
Dataset1-V2-M4
-min-33
Dataset1-V2-M5
-min-35
Dataset1-V2-M3
-min-17
Dataset1-V3-M1
-min-34
Dataset1-V3-M4
-min-31
Dataset1-V3-M5
-min-32
Dataset1-V3-M3
-min-15
Dataset2-V1-M1
-min-28
Dataset2-V1-M4
-min-31
Dataset2-V1-M5
-min-36
Dataset2-V1-M3
-min-23
Dataset2-V2-M1
-min-25
Dataset2-V2-M4
-min-32
Dataset2-V2-M5
-min-31
Dataset2-V2-M3
-min-25
Dataset2-V3-M1
-min-29
Dataset2-V3-M4
-min-32
Dataset2-V3-M5
-min-34
Dataset2-V3-M3
-min-17


Dataset3-V1-M1
-min-27
Dataset3-V1-M4
-min-32
Dataset3-V1-M5
-min-34
Dataset3-V1-M3
-min-25
Dataset3-V2-M1
-min-29
Dataset3-V2-M4
-min-29
Dataset3-V2-M5
-min-37
Dataset3-V2-M3
-min-20
Dataset3-V3-M1
-min-29
Dataset3-V3-M4
-min-25
Dataset3-V3-M5
-min-36
Dataset3-V3-M3
-min-20
Dataset4-V1-M1
-min-32
Dataset4-V1-M4
-min-28
Dataset4-V1-M5
-min-38
Dataset4-V1-M3
-min-17
Dataset4-V2-M1
-min-25
Dataset4-V2-M4
-min-18
Dataset4-V2-M5
-min-35
Dataset4-V2-M3
-min-23
Dataset4-V3-M1
-min-29
Dataset4-V3-M4
-min-30
Dataset4-V3-M5
-min-39
Dataset4-V3-M3
-min-20

3.6 Some observations and possible explanations

1. oriSurround is doing great in predicting wavy stimuli
2. oriSurround has a dominant performance in V1 area. This could because, in V1 the second order contrast effect is not so significant.

To explore why, we can first seperate the dataset into different small group and calculte RMSE or R2 of each group to see the performance of each model within group.

[ ]: