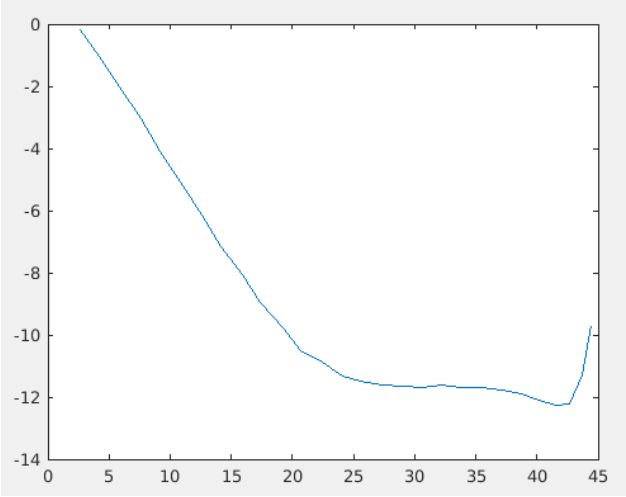
light_data_2.28/mix_amp/：混合 snr 数据作为训练数据，且数据归一化（3.1 时都为 2 层非线性层，numHiddenUnits=25）

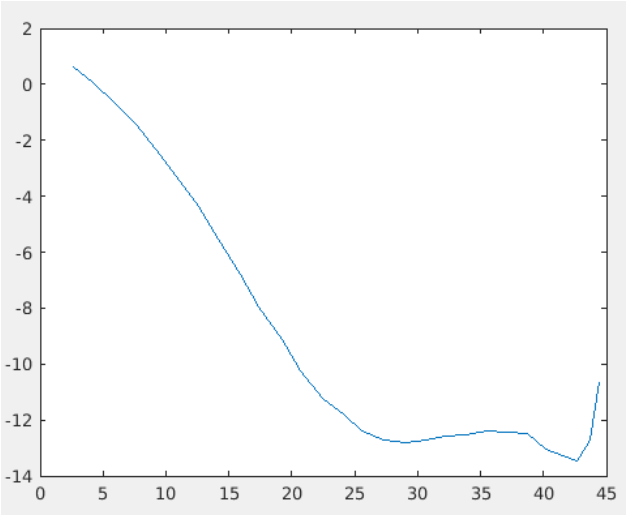
1. mix_amp/Twononlinear

```
twononlinear ,
ini learningRate = 1.000000e-03 ,
min batch size = 400 ,
DropPeriod = 5 ,
DropFactor = 0.100000 ,
amp begin = -4 , amp end = 50 , amp step = 2 ,
data_num = 80
```



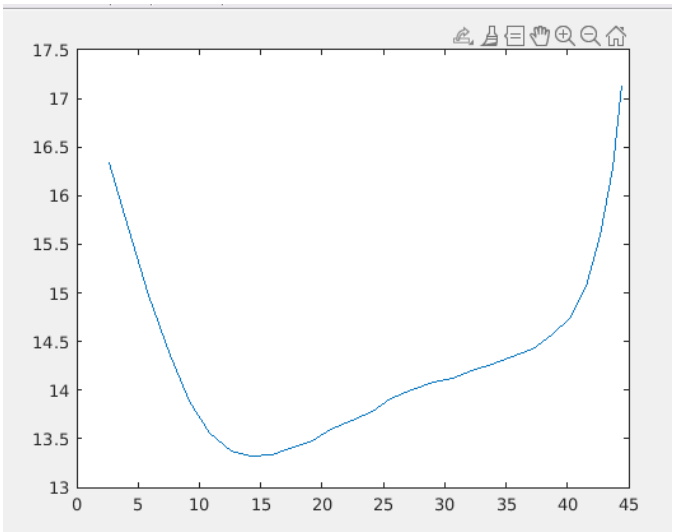
2. mix_amp/Twononlinear2

```
twononlinear ,
ini learningRate = 1.000000e-03 ,
min batch size = 400 ,
DropPeriod = 5 ,
DropFactor = 0.100000 ,
amp begin = -4 , amp end = 50 , amp step = 2
data_num = 100
```



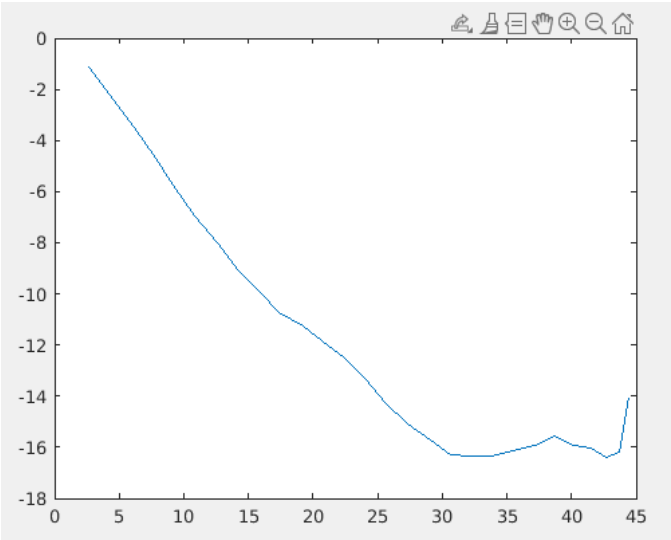
3. mix_amp/Twononlinear3

```
twononlinear ,
ini learningRate = 1.000000e-04 ,
min batch size = 400 ,
DropPeriod = 5 ,
DropFactor = 0.100000 ,
amp begin = -4 , amp end = 50 , amp step = 2
data_num = 100
```



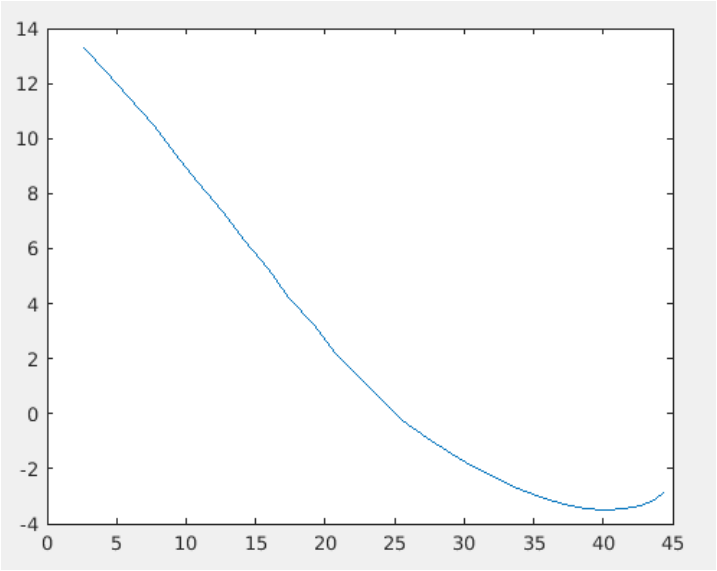
4. mix_amp/Twononlinear4

```
twononlinear ,
ini learningRate = 1.000000e-02 ,
min batch size = 400 ,
DropPeriod = 5 ,
DropFactor = 0.100000 ,
amp begin = -4 , amp end = 50 , amp step = 2
data_num = 100
```



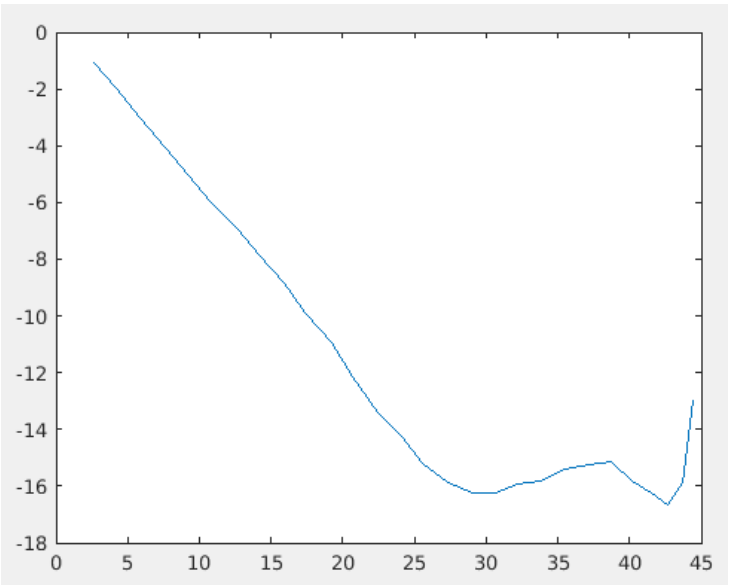
5. mix_amp/Twononlinear5

```
twononlinear ,
ini learningRate = 1.000000e-01 ,
min batch size = 400 ,
DropPeriod = 5 ,
DropFactor = 0.100000 ,
amp begin = -4 , amp end = 50 , amp step = 2
data_num = 100
```



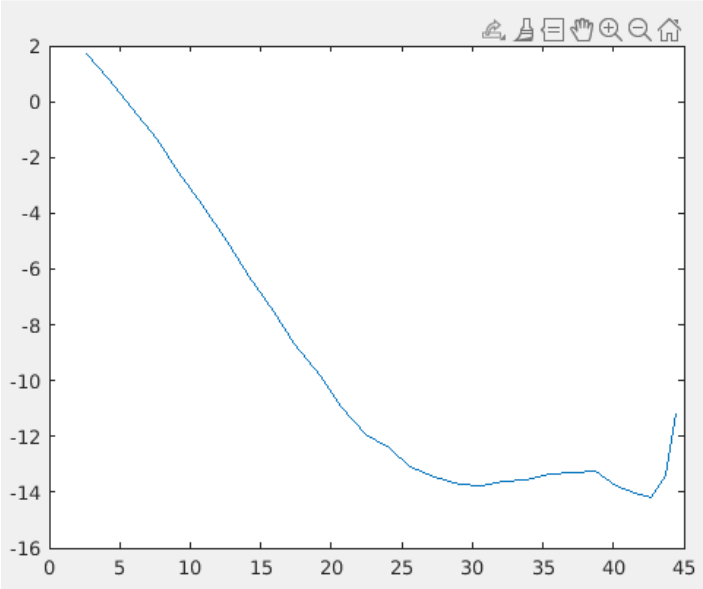
6. mix_amp/Twononlinear6

```
twononlinear ,
ini learningRate = 1.000000e-02 ,
min batch size = 1200 ,
DropPeriod = 5 ,
DropFactor = 0.100000 ,
amp begin = -4 , amp end = 50 , amp step = 2
data_num = 100
validationFrequency has changed from floor(size(xTrain{1},2)/miniBatchSize) to floor(size(xTrain{1},2)/100)
```



7. mix_amp/Twononlinear7

```
twononlinear ,
ini learningRate = 1.000000e-02 ,
min batch size = 1800 ,
DropPeriod = 5 ,
DropFactor = 0.100000 ,
amp begin = -4 , amp end = 50 , amp step = 2
data_num = 100
validationFrequency has changed from floor(size(xTrain{1},2)/miniBatchSize) to floor(size(xTrain{1},2)/100)
```

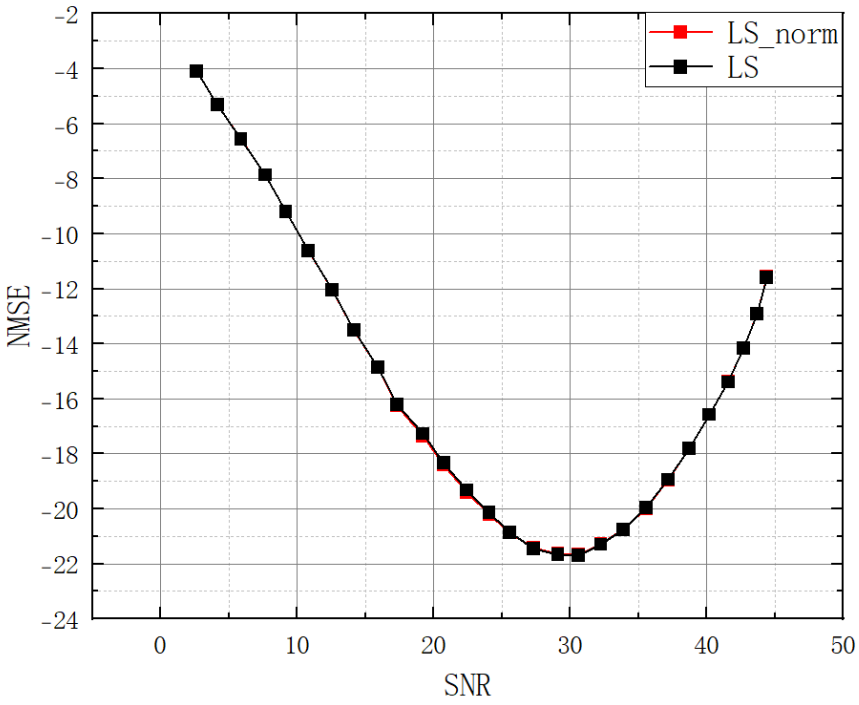


single_amp/：单一 snr 数据作为训练数据，且数据归一化

LS/：数据只乘了 100*1.1^amp，没有乘上归一化因子

norm_LS/：数据不仅乘了 100*1.1^amp，还乘上了归一化因子

从图中看，乘不乘归一化因子没有区别



optimal_nmse/：不同 snr 下的最佳 nmse，等于

$$10 * \log_{10}\left(\frac{\text{Power（noise）}}{\text{Power（y）}}\right)$$

建模的准确度的理论下界：

$$NMSE_{optimal} = 10\log_{10}\frac{\sum_{n=1}^{N}|y(n)-\hat{y}_{optimal}(n)|^2}{\sum_{n=1}^{N}|y(n)|^2} = 10\log_{10}\frac{\sum_{n=1}^{N}|z(n)|^2}{\sum_{n=1}^{N}|y(n)|^2} = 10\log_{10}\frac{\sum_{n=1}^{N}|z(n)|^2}{\sum_{n=1}^{N}|f(\boldsymbol{x})(n)+z(n)|^2} \quad (3.51)$$

其中 $z(n)$ 表示加性噪声，$f(\cdot)$ 表示信道的时域传输函数，包括信道的非线性与记忆性特性。