# 1. 遗传寻优设置

1. 编码方式：Encoding = 'RI'
2. 种群规模：NIND = 30
3. 算法模板：ea.soea_SEGA_templet
4. 最大进化代数：MAXGEN = 100
5. “进化停滞”判断阈值：trappedValue = 1e-6
6. 进化停滞计数器最大上限值：maxTrappedCount = 20
7. 交叉验证折数：CV=10
8. 训练集+验证集：[ 6426 , 10427 ] len: 4001 **【四折交叉验证**，验证集长度1000】
9. 测试集：[ 14389 , 15388 ] len: 1000
10. **输入空间：wind_speed、 sin(wind_direction)、 cos(wind_direction)**
11. 预测：wind_power

# 2. 模型组合方式

- 1. **Base**
    - 1.1: default_tree_learner
    - 1.2: default_linear_learner(ridge)
    - 1.3: lasso_learner
    - 1.4: kernel_ridge_learner
    - 1.5: linear_svr_learner
- 2. **ESN + Base:**
    - 2.1 esn_ridge_learner
    - 2.2 esn_lasso_learner
    - 2.3 esn_kernel_ridge_learner
    - 2.4 esn_linear_svr_learner
- 3. **NGBoost(Base):**
    - model_test(Base)
- 4. **NGBoost(ESN + Base):**
    - model_test(ESN + Base)
- 5. **ESN + NGBoost(Base):**
    - esn_model_test(Base)

# 3. 结果

## 3.1 esn_ridge_learner

**esn 默认参数：**

1. n_readout=1000

2. n_components=100
3. damping = 0.5
4. weight_scaling = 0.9
5. alpha = 1（在 ridge 上的最优参数）
6. **Test mse：0.01642650566799493（测试集长度1000）**

**寻优结果：**

1. 最优MSE：0.015390469160833288（验证集长度1000）
2. **Test mse：0.016440854213573736（测试集长度1000）**
3. **最优控制变量值：**（变量搜索范围）

   **n_readout=3462** (1, 10000] int

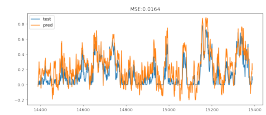
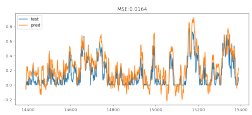
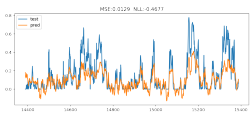
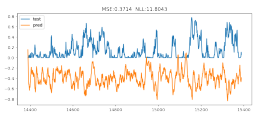
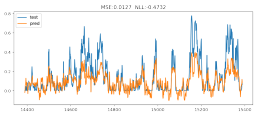
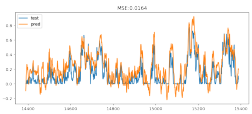
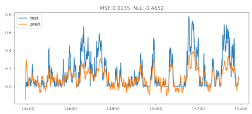
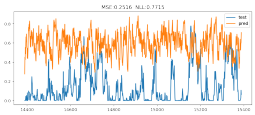
   **n_components=23** (1, 2000] int

   **damping = 0.26215546327467487** (0, 1] float

   **weight_scaling = 0.6234509481681756** (0.5, 1] float

   **alpha = 0.4649085531487292** (0, 1] float
4. 有效进化代数：38
5. 最优的一代是第 18 代
6. 评价次数：1140
7. 使用时间： 3297 秒

**模型对比：**

| 模型 | 1. ridge | 2.1 esn+ridge [default] | 4.1 ngboost(ens+ridge) [default] | 5.1 esn+ngboost(ridge) [default] |
|---|---|---|---|---|
| 默认参数设置 | **alpha=1** | **alpha=1 n_readout=1000 n_components=100 damping = 0.5 weight_scaling = 0.9** | **alpha=1** n_estimators=500 learning_rate=0.01 Score=MLE **n_readout=1000 n_components=100 damping = 0.5 weight_scaling = 0.9** | **alpha=1** n_estimators=500 learning_rate=0.01 Score=CRPS **n_readout=1000 n_components=100 damping = 0.5 weight_scaling = 0.9** |
| MSE | 0.0163812 | 0.01641301 | 0.01287494 | 0.3714271 |
| 图 |  |  |  |  |
| 模型 | 3. ngboost(ridge) | 2.2 esn+ridge [GA] | 4.2 ngboost(ens+ridge) [GA] | 5.2 esn+ngboost(ridge) [GA] |
| 参数设置 | **alpha=1** n_estimators=500 learning_rate=0.01 Score=MLE | **alpha=0.4649085531 n_readout=3462 n_components=23 damping = 0.26215546 weight_scaling = 0.623450948** | **alpha=0.4649085531** n_estimators=500 learning_rate=0.01 Score=MLE **n_readout=3462 n_components=23 damping = 0.26215546 weight_scaling = 0.623450948** | **alpha=0.4649085531** n_estimators=500 learning_rate=0.01 Score=CRPS **n_readout=3462 n_components=23 damping = 0.26215546 weight_scaling = 0.623450948** |
| MSE | 0.0126617 | 0.016440854 | 0.013522998 | 0.25163414 |
| 图 |  |  |  |  |

**对比 X.1 （默认参数）模型与 X.2 （遗传寻优参数）模型，遗传寻优后的 esn 参数值的表现甚至不如默认参数**