

Figure 1: (Upper)The number of parameters of each model (Lorenz-96, p=100, T=1000). (Bottom) The trend of KANGCI's parameter as the time series dimension increases.

Table 1: AUPRC of the Lorenz-96 dataset.

| | AUROC | | | |
|--------------|-------------------------------|----------------------------------|---|--|
| Models | p = 10, F = 10 T = 1000 | p = 40, F = 40 T = 1000 | p = 40, F = 40 T = 500 | |
| cMLP | 0.968 ± 0.002 | 0.791 ± 0.012 | 0.685 ± 0.057 | |
| cLSTM | 0.964 ± 0.004 | 0.865 ± 0.015 | 0.726 ± 0.035 | |
| TCDF | 0.732 ± 0.012 | 0.524 ± 0.042 | 0.445 ± 0.122 | |
| eSRU | $1.0 {\pm} 0.00$ | 0.943 ± 0.007 | 0.893 ± 0.023 | |
| GVAR | $1.0{\pm0.00}$ | 0.925 ± 0.009 | 0.886 ± 0.036 | |
| NAVAR (MLP) | 0.989 ± 0.005 | 0.742 ± 0.041 | 0.631 ± 0.079 | |
| NAVAR (LSTM) | 0.991 ± 0.005 | 0.784 ± 0.037 | 0.682 ± 0.071 | |
| $_{ m JGC}$ | 0.987 ± 0.004 | 0.923 ± 0.029 | 0.843 ± 0.044 | |
| CUTS+ | $1.0 {\pm} 0.00$ | 0.979 ± 0.003 | 0.925 ± 0.024 | |
| JRNGC | $1.0 {\pm} 0.00$ | 0.966 ± 0.006 | 0.892 ± 0.035 | |
| KANGCI | $1.0 {\scriptstyle \pm 0.00}$ | $0.990 {\scriptstyle \pm 0.003}$ | $\boldsymbol{0.953} {\scriptstyle \pm 0.021}$ | |

Table 2: AUPRC of the Dream-3 dataset, T=966, p=100 $\,$

| Models | | | AUROC | | |
|--------------|---------|---------|---------|---------|---------|
| | Ecoli-1 | Ecoli-2 | Yeast-1 | Yeast-2 | Yeast-3 |
| cMLP | 0.023 | 0.019 | 0.020 | 0.015 | 0.014 |
| cLSTM | 0.017 | 0.017 | 0.015 | 0.023 | 0.031 |
| TCDF | 0.012 | 0.011 | 0.014 | 0.014 | 0.013 |
| eSRU | 0.036 | 0.034 | 0.041 | 0.052 | 0.044 |
| GVAR | 0.103 | 0.117 | 0.098 | 0.103 | 0.104 |
| NAVAR (MLP) | 0.102 | 0.107 | 0.073 | 0.105 | 0.089 |
| NAVAR (LSTM) | 0.013 | 0.012 | 0.030 | 0.038 | 0.052 |
| $_{ m JGC}$ | 0.018 | 0.016 | 0.026 | 0.050 | 0.059 |
| CUTS+ | 0.154 | 0.143 | 0.121 | 0.128 | 0.105 |
| JRNGC | 0.198 | 0.202 | 0.172 | 0.142 | 0.130 |
| KANGCI | 0.177 | 0.163 | 0.154 | 0.138 | 0.132 |

Table 3: AUPRC of the VAR dataset.

| | AUROC | | | |
|--------------|-------------------|-------------------|-------------------------------|--|
| Models | p = 10, T = 1000 | p = 10, T = 1000 | p = 10, T = 1000 | |
| | sparsity = 0.2 | sparsity = 0.3 | sparsity = 0.2 | |
| | lag = 3 | lag = 3 | lag = 5 | |
| cMLP | 1.0±0.00 | 0.832±0.006 | 0.973±0.004 | |
| cLSTM | 0.964 ± 0.005 | 0.854 ± 0.006 | 0.911 ± 0.006 | |
| TCDF | 0.812 ± 0.013 | 0.681 ± 0.012 | 0.734 ± 0.012 | |
| eSRU | 1.0 ± 0.00 | 0.989 ± 0.002 | $\boldsymbol{1.0} {\pm} 0.00$ | |
| GVAR | 1.0 ± 0.00 | 0.985 ± 0.003 | $\boldsymbol{1.0} {\pm} 0.00$ | |
| NAVAR (MLP) | 0.987 ± 0.003 | 0.943 ± 0.006 | 0.981 ± 0.004 | |
| NAVAR (LSTM) | 0.985 ± 0.003 | 0.957 ± 0.007 | 0.959 ± 0.003 | |
| $_{ m JGC}$ | 1.0 ± 0.00 | 0.990 ± 0.002 | 1.0 ± 0.00 | |
| CUTS+ | 1.0 ± 0.00 | $1.0 {\pm} 0.00$ | 1.0 ± 0.00 | |
| JRNGC | $1.0 {\pm 0.00}$ | 0.992 ± 0.002 | 1.0 ± 0.00 | |
| KANGCI | 1.0±0.00 | 0.987 ± 0.002 | 1.0±0.00 | |

| Table 4: AUPRC of the fMRI BOLD | | | | |
|---------------------------------|---|---------------------------------|--|--|
| Dateset . | | AUROC | | |
| | CUTS+ | JRNGC | KANGCI | |
| Sim1 | 0.704 ± 0.08 | 0.688 ± 0.07 | 0.672 ± 0.09 | |
| Sim2 | 0.694 ± 0.07 | $0.682{\scriptstyle\pm0.06}$ | $\boldsymbol{0.701} {\pm 0.07}$ | |
| Sim3 | $0.638{\scriptstyle\pm0.07}$ | $\boldsymbol{0.651} {\pm 0.08}$ | $0.636{\scriptstyle\pm0.06}$ | |
| Sim4 | $0.643 {\pm} 0.06$ | $0.632{\scriptstyle\pm0.06}$ | 0.601 ± 0.03 | |
| Sim5 | $0.728{\scriptstyle\pm0.05}$ | $0.731 {\pm} 0.06$ | $\boldsymbol{0.739} {\scriptstyle \pm 0.05}$ | |
| Sim6 | $0.734{\scriptstyle\pm0.06}$ | $0.729{\scriptstyle\pm0.07}$ | $\boldsymbol{0.748} {\scriptstyle\pm0.07}$ | |
| $\operatorname{Sim} 7$ | $0.744{\scriptstyle\pm0.07}$ | $0.721{\scriptstyle\pm0.07}$ | $\boldsymbol{0.793} {\scriptstyle\pm0.07}$ | |
| Sim8 | $0.635{\scriptstyle\pm0.08}$ | $0.621{\scriptstyle\pm0.04}$ | $\boldsymbol{0.654} {\scriptstyle\pm0.11}$ | |
| Sim9 | $0.698{\scriptstyle\pm0.05}$ | $0.685 {\pm} 0.05$ | $\boldsymbol{0.719} {\scriptstyle\pm0.08}$ | |
| Sim10 | $0.678{\scriptstyle\pm0.04}$ | $0.663{\scriptstyle\pm0.08}$ | $\boldsymbol{0.692} {\scriptstyle \pm 0.09}$ | |
| Sim11 | $0.695{\scriptstyle\pm0.05}$ | $0.682{\scriptstyle\pm0.08}$ | $0.621{\scriptstyle\pm0.07}$ | |
| Sim12 | $0.660{\scriptstyle\pm0.06}$ | 0.649 ± 0.07 | $\boldsymbol{0.678} {\scriptstyle \pm 0.06}$ | |
| Sim13 | $0.696{\scriptstyle\pm0.05}$ | 0.720 ± 0.08 | $\boldsymbol{0.744} {\scriptstyle\pm0.08}$ | |
| Sim14 | $0.657{\scriptstyle\pm0.04}$ | 0.642 ± 0.06 | $\boldsymbol{0.686} {\scriptstyle \pm 0.09}$ | |
| Sim15 | 0.641 ± 0.07 | 0.632 ± 0.09 | $\boldsymbol{0.659} {\pm 0.07}$ | |
| Sim16 | $0.654{\scriptstyle\pm0.11}$ | $0.668{\scriptstyle\pm0.12}$ | $\boldsymbol{0.688} {\scriptstyle \pm 0.09}$ | |
| Sim17 | $\boldsymbol{0.724} \scriptstyle{\pm 0.04}$ | $0.721{\scriptstyle\pm0.05}$ | $0.714{\scriptstyle\pm0.05}$ | |
| Sim18 | 0.710 ± 0.06 | $0.696 {\pm} 0.08$ | $\boldsymbol{0.725} {\scriptstyle\pm0.09}$ | |
| Sim19 | 0.847 ± 0.07 | $0.833 {\pm} 0.04$ | $\boldsymbol{0.873} {\scriptstyle \pm 0.03}$ | |
| Sim20 | 0.861 ± 0.07 | $0.857{\pm0.05}$ | $\boldsymbol{0.886} {\scriptstyle \pm 0.04}$ | |
| Sim21 | $0.696{\scriptstyle\pm0.08}$ | $0.677{\pm0.06}$ | $\boldsymbol{0.711} {\scriptstyle \pm 0.07}$ | |
| Sim22 | $0.727{\pm0.04}$ | $0.722{\scriptstyle\pm0.06}$ | $\boldsymbol{0.746} {\scriptstyle \pm 0.09}$ | |
| Sim 23 | $0.551{\scriptstyle\pm0.06}$ | $0.544 {\pm} 0.08$ | $0.527{\scriptstyle\pm0.11}$ | |
| Sim24 | $0.490{\scriptstyle\pm0.08}$ | $0.504 {\pm} 0.08$ | $0.476{\scriptstyle\pm0.09}$ | |
| Sim25 | $0.643 {\pm} 0.05$ | 0.649 ± 0.07 | $\boldsymbol{0.661} {\pm 0.08}$ | |
| Sim26 | $0.561{\scriptstyle\pm0.09}$ | $0.561{\scriptstyle\pm0.08}$ | $\boldsymbol{0.632} {\scriptstyle \pm 0.12}$ | |
| Sim 27 | $0.661 {\pm} 0.07$ | 0.634 ± 0.09 | $\boldsymbol{0.672} {\pm 0.08}$ | |
| Sim28 | $0.715{\scriptstyle\pm0.09}$ | $0.709{\scriptstyle\pm0.10}$ | $\boldsymbol{0.732} {\scriptstyle \pm 0.09}$ | |
| AVG | 0.681 ± 0.07 | $0.675{\pm0.09}$ | $0.691 {\pm} 0.09$ | |

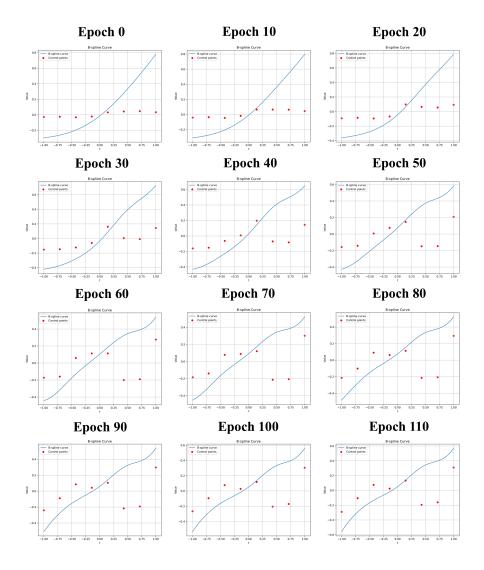


Figure 2: The visualization of the spline(x) function during the causal inference.

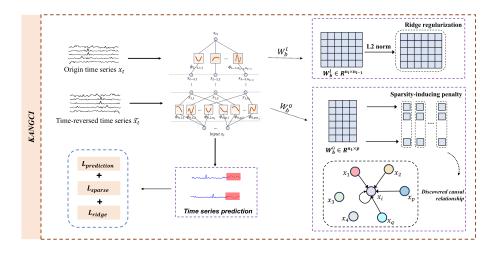


Figure 3: The architecture of KANGCI.