

Svelaro Causal Search against five methods

Three public industrial datasets with documented causes, six methods on identical data, settings fixed before scoring. Each is judged on the list it hands the engineer: how many variables to check, and how often the first is the true cause.

SIMULATED CHEMICAL PLANT Tennessee Eastman ^{1,2,3,4} 19 problems · 26 candidates · 22 runs	SIMULATED BATCH BIOPROCESS IndPenSim ^{5,6,7} 22 candidates · 15 causes, 7 consequences	OPERATING PLANT ESS cryoplant ^{8,9} 7.9 days · 151 tags · expert causal graph
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What each method hands the engineer

Tennessee Eastman, the nine problems where the data can answer

■ the true cause, averaged over the nine problems
 ■ other variables to check

METHOD	VARIABLES RETURNED, OF 26	RIGHT FIRST, OF 9	ABOVE CHANCE
Correlation	■ 24.2 to check · cause on list 9 of 9	○ ○ ○ ○ ○ ○ ○ ○ ○ 0	+0.6
Granger ¹⁰	■ 22.2 to check · cause on list 7 of 9	● ○ ○ ○ ○ ○ ○ ○ ○ 1	-0.7
PC ¹²	■ 4.1 to check · cause on list 4 of 9	● ○ ○ ○ ○ ○ ○ ○ ○ 1.1	+2.6
DYNOTEARS ¹³	returns nothing	○ ○ ○ ○ ○ ○ ○ ○ ○ 0	0
PCMCi+ ¹¹	■ 5.3 to check · cause on list 5 of 9	● ● ● ○ ○ ○ ○ ○ ○ 3	+3.2
SvelaroCS	■ 2.0 to check · cause on list 7 of 9	● ● ● ● ● ○ ○ ○ ○ 6	+6.3

Right first: PC is unordered, so averaged. Above chance: problems solved beyond a random pick of the same size.

Backwards answers, IndPenSim

■ true causes
 ■ consequences of the target
 of 22 candidates

Correlation	■ 14 + 7
Granger	■ 15 + 7
PC	■ 3 + 2
DYNOTEARS	returns nothing
PCMCi+	■ 5 + 0
SvelaroCS	■ 6 + 0

Consequences are created by the production rate itself, such as oxygen uptake: raising one to raise yield has the arrow backwards. Automatic-control batches, 6-hour resolution.

The data decides first

Whether a historian can answer depends on whether the plant moved while recording. We check that before any modelling. Share of variation inside one operating condition:

50%	Tennessee Eastman	moves with every fault
97%	IndPenSim	moves within every batch
1%	ESS cryoplant	held steady: 1 of 3 causes recoverable

Conclusions

Right first, from a short list. **SvelaroCS** names the true cause first in 6 of 9 problems from two variables; PCMCi+ in 3 from five, correlation in none from 24.

No backwards answers. On IndPenSim, **SvelaroCS** returns none of the seven consequences of the target; correlation and Granger return all seven.

Wrong, but close. 2 of the 3 **SvelaroCS** misses lie within two steps of the true cause; correlation and Granger miss by a median of six.

Study by **Svelaro GmbH**; **SvelaroCS** is **Svelaro's** method, one of the six compared.

[Read the full study →](#)

[1] Downs, Vogel. Comput. Chem. Eng. 1993 [doi](#) ↗

[2] Chiang, Russell, Braatz. Springer 2001 [doi](#) ↗

[3] Russell, Chiang, Braatz. Chemom. Intell. Lab. Syst. 2000 [doi](#) ↗

[4] Menegozzo et al. CIPCaD-Bench, IEEE CASE 2022 [doi](#) ↗

[5] Goldrick et al. J. Biotechnol. 2015 [doi](#) ↗

[6] Goldrick et al. Comput. Chem. Eng. 2019 [doi](#) ↗

[7] Goldrick. IndPenSim data, Mendeley 2019 [doi](#) ↗

[8] Mogensen, Rathsmann, Nilsson. CLeaR 2024 [link](#) ↗

[9] Rathsmann, Nilsson, Mogensen. Zenodo 2024 [doi](#) ↗

[10] Granger. Econometrica 1969 [doi](#) ↗

[11] Runge. PCMCi+, UAI 2020 [link](#) ↗

[12] Spirtes, Glymour. PC, Soc. Sci. Comput. Rev. 1991 [doi](#) ↗

[13] Pamfil et al. DYNOTEARS, AISTATS 2020 [link](#) ↗

Try it on your plant.

Name the quality problem; we hand back the short list worth checking.

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Book a meeting →