

# Enhancing Model-Based Diagnosis with Multiple Pseudo-Normal Observations: Key Nodes and IterativeDFS for Improved Diagnostic Efficiency

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## Model-based diagnosis with multiple pseudo-normal observations

- Existing approaches to model-based diagnosis (MBD) with multiple observations are unable to make use of the normal observations that appear inside pseudo-normal observation sets. Instead, they simply discard these observations and analyze the abnormal ones. In this paper, we introduce **DKIPNO**, an algorithm that converts the normal observations into additional system knowledge. This extra information lets DKIPNO certify a larger set of components as normal in advance, which cuts down the number of components that need be explored and shortens overall computation time.

**Observation 1 (Fault-revealing):** For  $i_1 = 0, i_2 = 1$ :

$$\text{Normal: } G_1(0, 1) = 0, G_2(1) = 0, G_3(0, 0) = 0 \implies o_1 = 0,$$

$$\text{Faulty: } G_1(0, 1) = 1, G_2(1) = 0, G_3(1, 0) = 1 \implies o_1 = 1.$$

Thus,

$$SD_1 \wedge Obs_1 \wedge \left( \neg Ab(G_1) \wedge \neg Ab(G_2) \wedge \neg Ab(G_3) \right) \models \perp.$$

**Observation 2 (Pseudo-normal):** For  $i_1 = 1, i_2 = 0$ :

$$\text{Normal: } G_1(1, 0) = 0, G_2(0) = 1, G_3(0, 1) = 1 \implies o_1 = 1,$$

$$\text{Faulty: } G_1(1, 0) = 1, G_2(0) = 1, G_3(1, 1) = 1 \implies o_1 = 1.$$

# Experimental results

- Experiments demonstrate that DKIPNO is more efficient than state-of-the-art algorithms HSD, IHSD, and DiagDO when computing both minimal-subset and minimal-cardinality diagnoses. Moreover, DKIPNO produces diagnostic solutions within the given time limits for substantially larger circuits, while other state-of-the-art algorithms cannot.

