Monthly Report

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Outlines

Multiple Models for Risk Assessment

Simulation

Task Planning

Multiple Models for Risk Assessment

Seven Factors about the Risk

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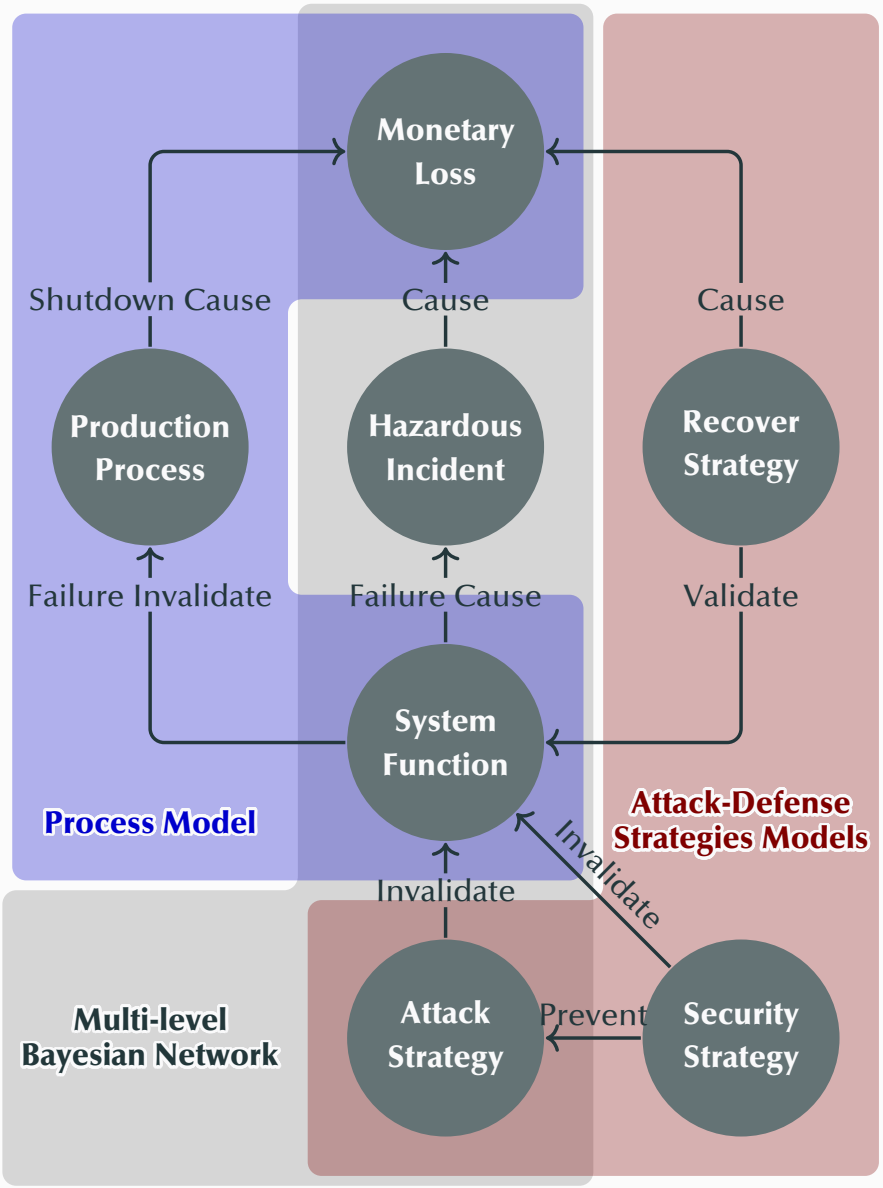
- **Production Process** refers a manufacturing step which is a part of in a production chain.
- **Monetary Loss** is the sum of the loss caused by malicious attacks, the loss of production process shutdown, and the enforcement cost of defense strategy.

The relationships amongst these seven factors

- The attack strategy can invalidate the system function.



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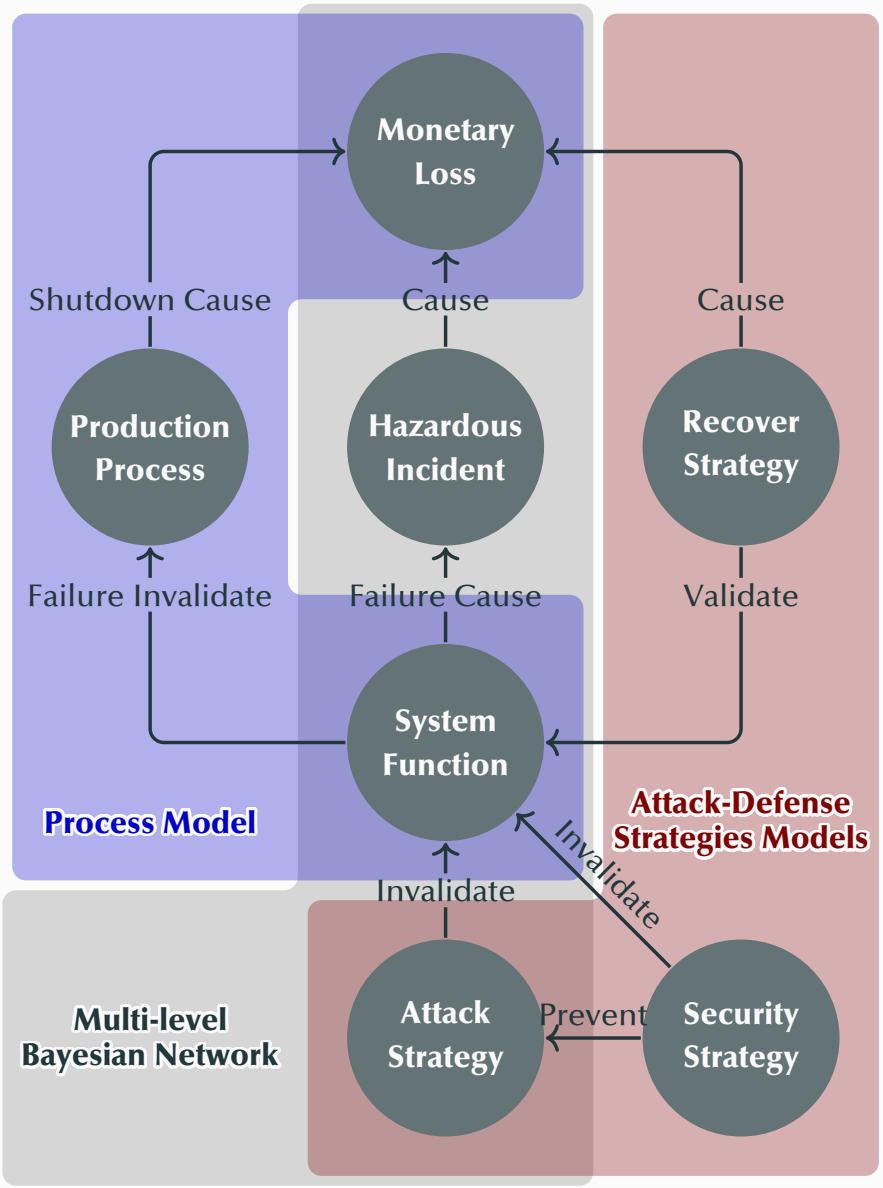

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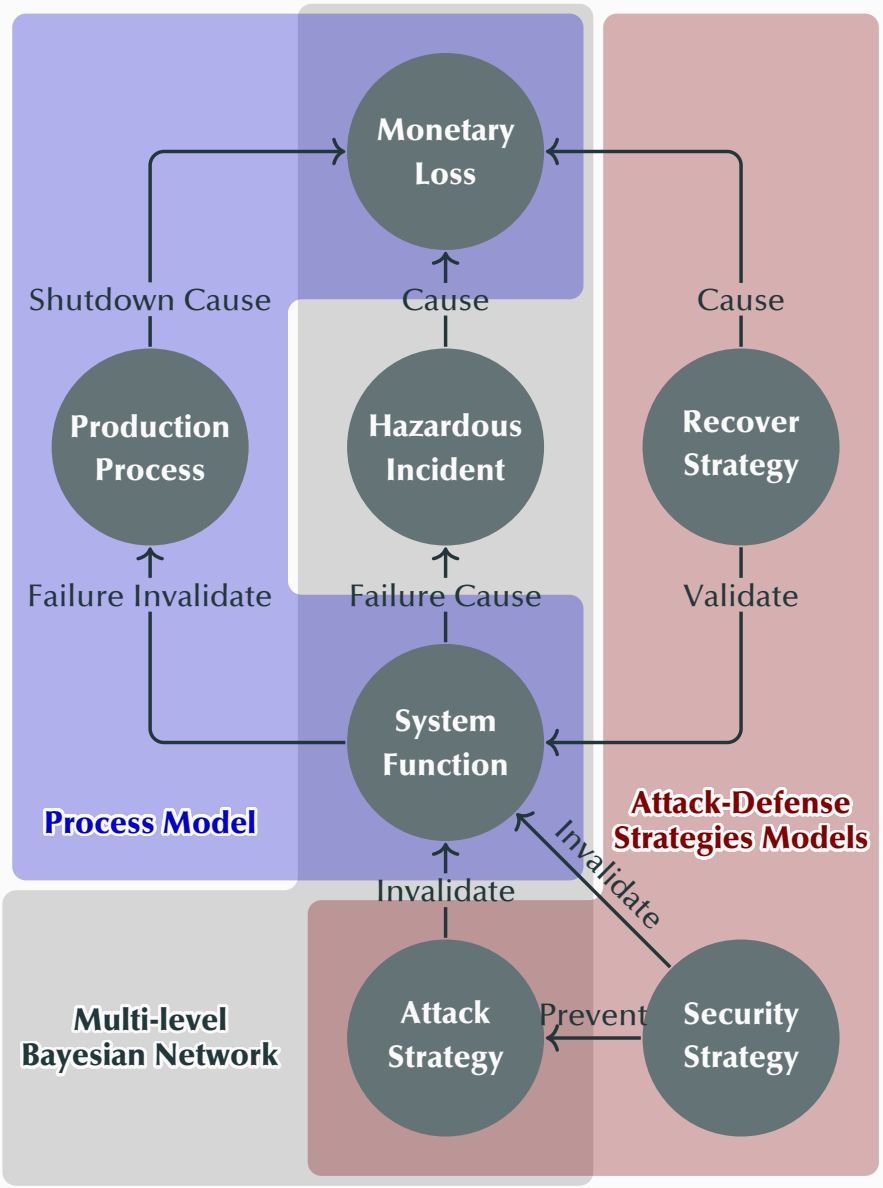

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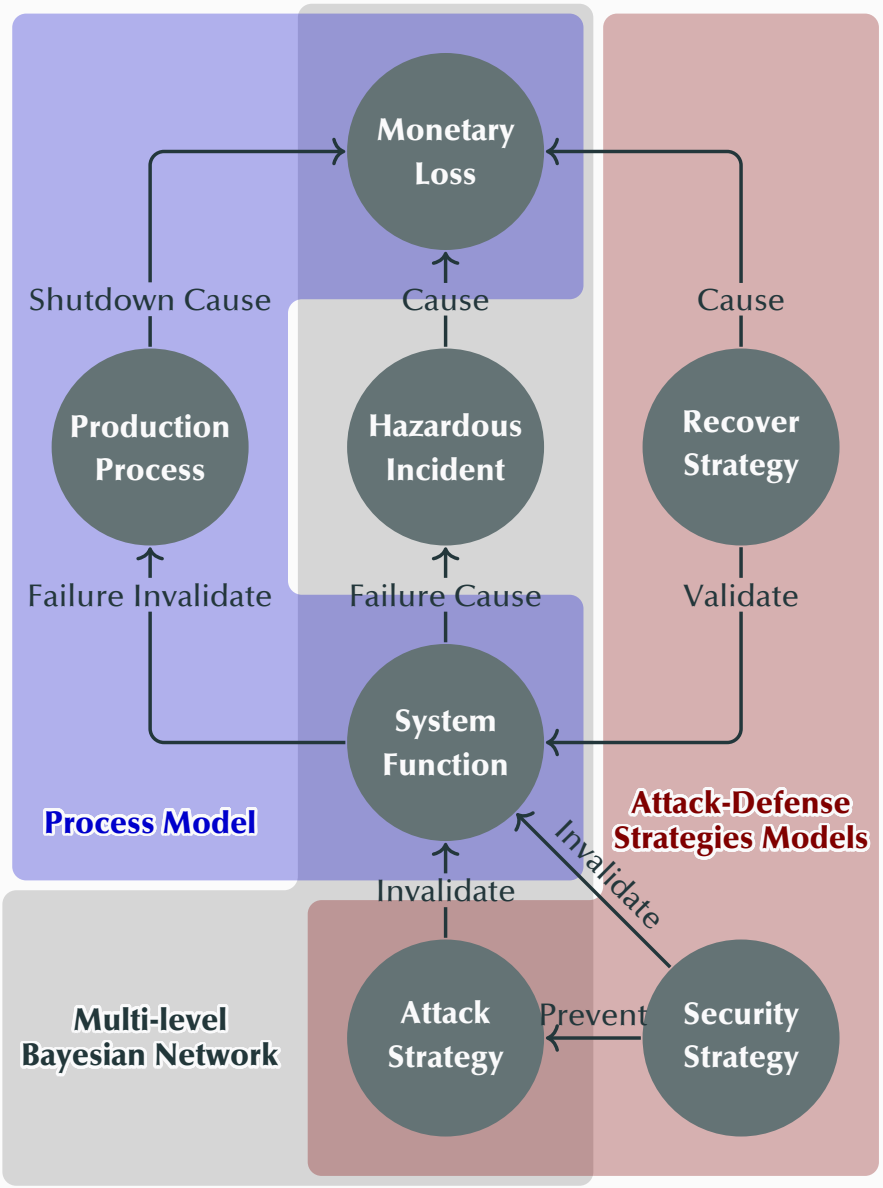

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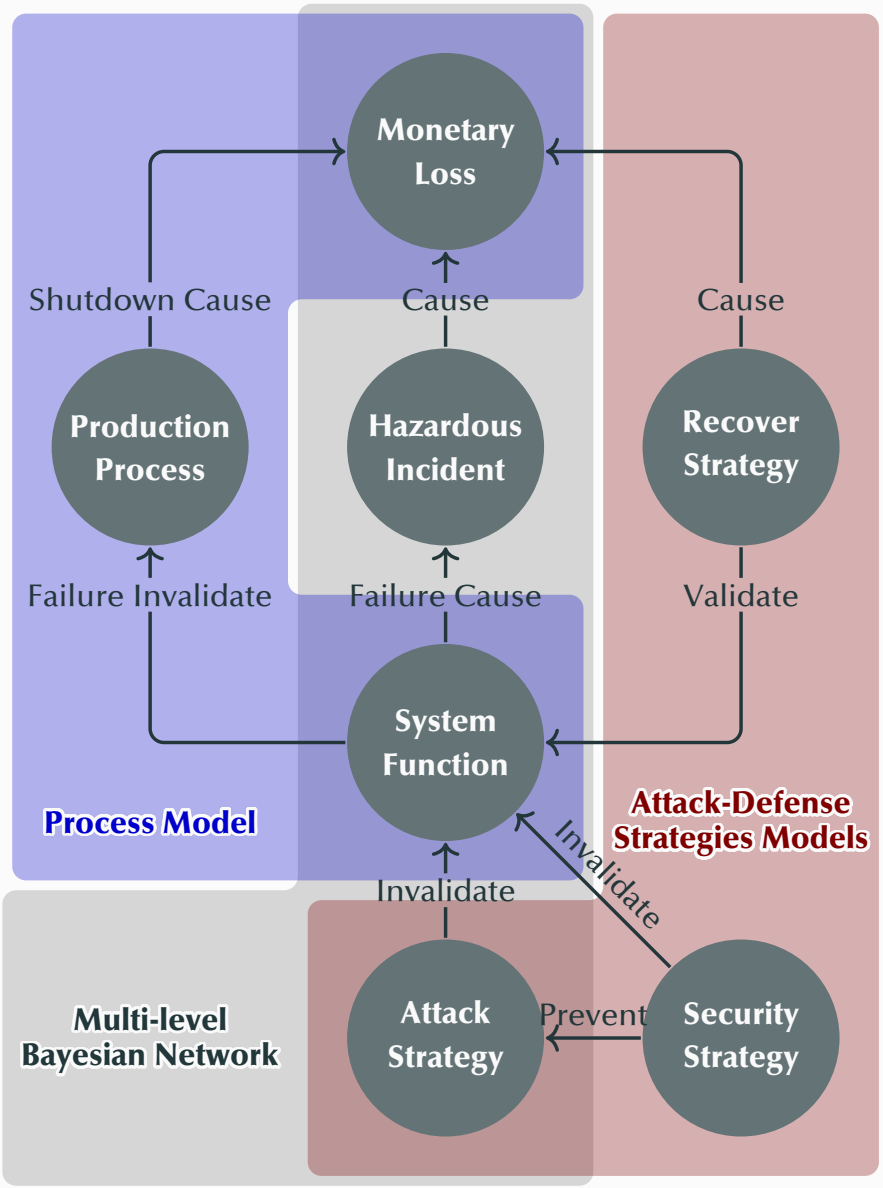
- The security strategy will prevent the enforcement of attack strategy, but its side effect is that it may invalidate the system function.
- The recover strategy has ability of recovering the failed system function, and it has the enforcement cost.



Multiple Models of Risk Assessment for ICSs

The following three models are used to described the relationships amongst these seven factors.

- The **multi-level Bayesian network**, involves attack strategy, system function, hazardous incident, and monetary loss. This model uses Bayesian network to describe the causal relationship of these four factors and it can be used to assess the risk caused by the malicious attacks.

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- The **process model** involves system functions, production process, and monetary loss. It can be used to calculate the risk cause by the degradation of control system.
- The **attack-defense strategies models**, include attack strategy model, security strategy model, and recover strategy model. These three models contain the relationships amongst these three kinds of strategies and system functions, and they can be used to quantify the cost and benefit of attack-defense strategies.

Simulation

A Failed Attempt — C++ Version

I had implemented the class `Node` and the class `BayesianNetwork` with C++ language.

The inference of Bayesian network is provided by `dlib`, which is a C++ library. But the computation time of the Bayesian network inference is 30 times slower than that of the implementation by Matlab.

Runtime Environment	Computation Time(ms)
C++ in Debug Mode	40,000
C++ in Release Mode	3,600
Matlab	90

The Matlab has optimized the algorithm for a large amount of computation.

Task Planning

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- Finish the simulation of 2nd paper.
- Finish the 3rd paper for the special issue on Fuzzy Systems.