Cyber-Physical & IoT Systems Design (CISD) Consortium

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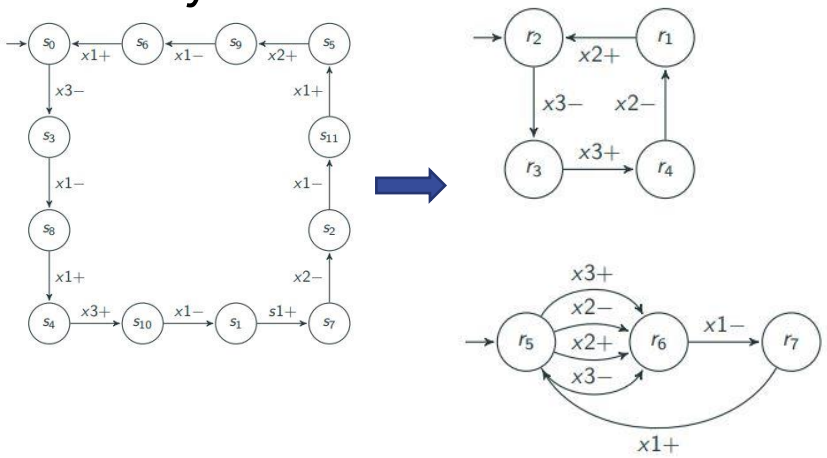
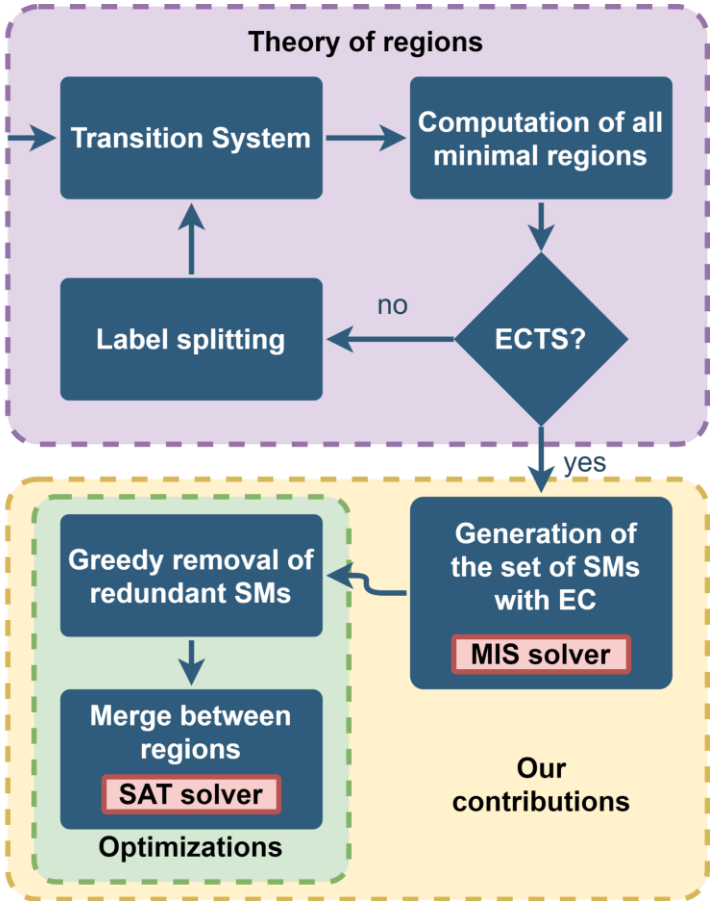
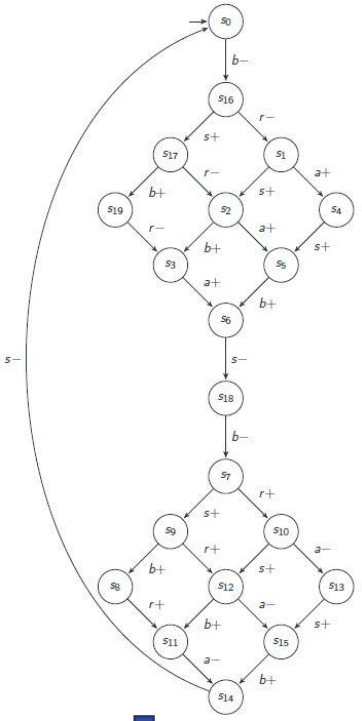
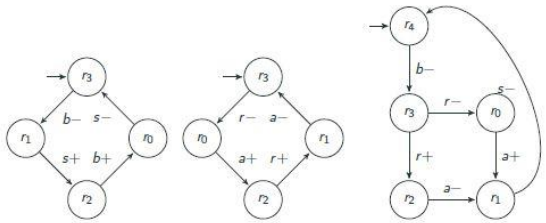
Decomposition of Transition Systems into sets of synchronized State Machines [1]

- Automatic methodology for the **decomposition** of **Transition Systems** into sets of **synchronized State Machines** based on **theory of regions**;
- **Extraction of concurrency** hidden in a Transition System.









FORMAL METHODS for ENGINEERING

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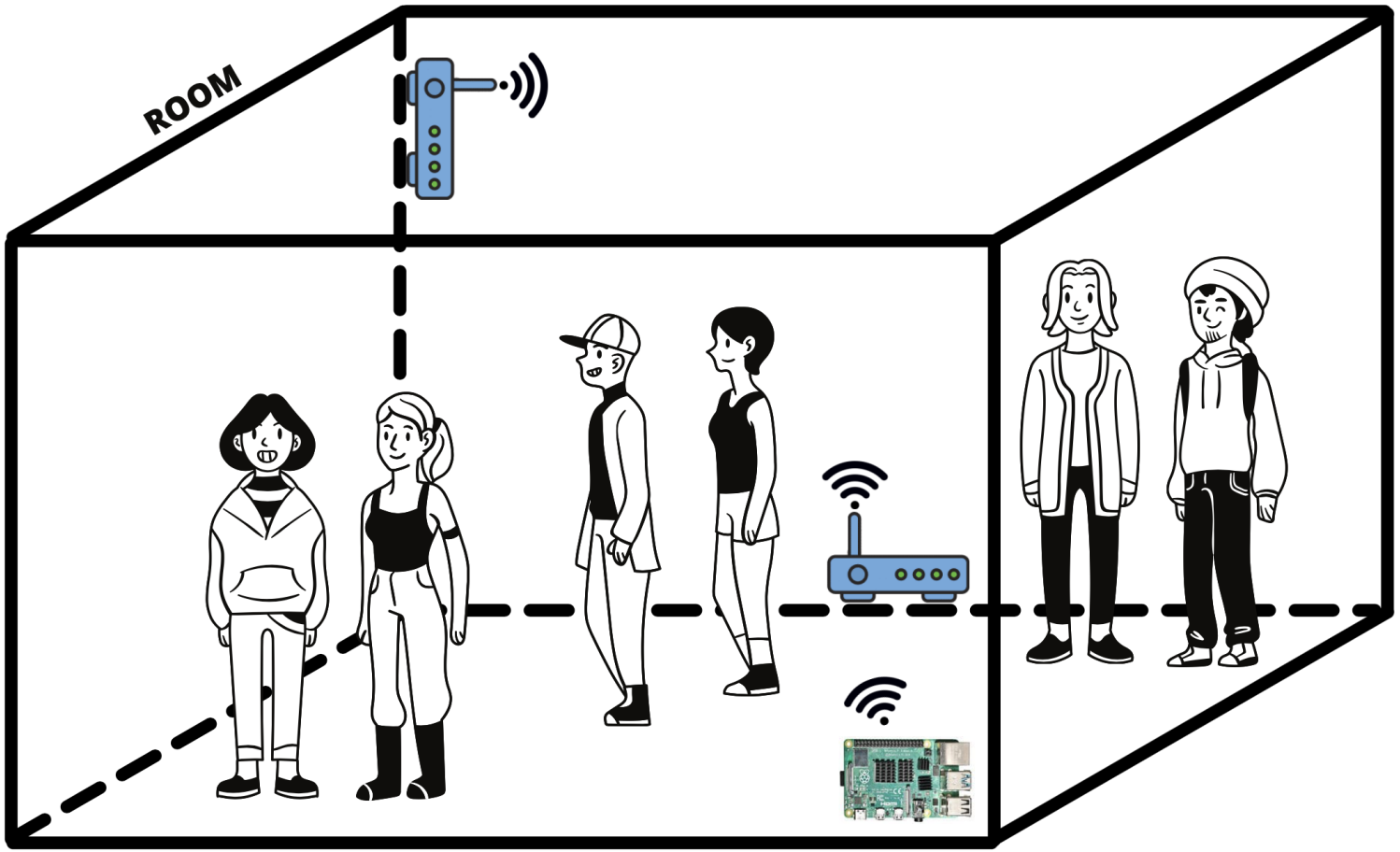
Exploiting WiFi Radio Signals [2, 3]



Analyse WiFi radio signals propagation patterns to:

- Deduce environment status
- Recognize person's identity
- Occupancy counting

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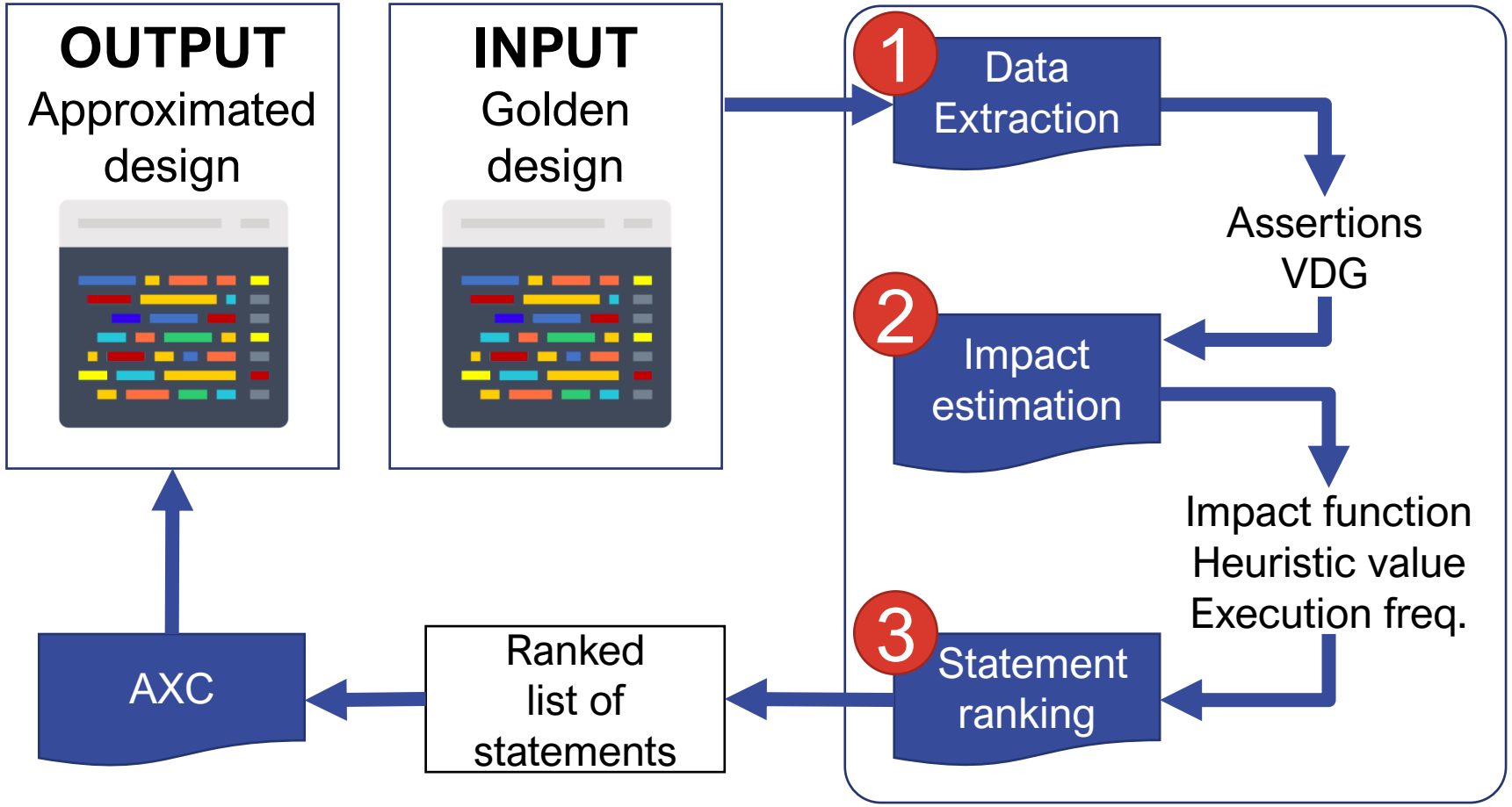
Statements identification for approximate computing



Automatic identification of design statements to be approximated by exploring the structure of the design and related assertions

ESD Electronic Systems Design
Synthesis Verification Testing Power Communication

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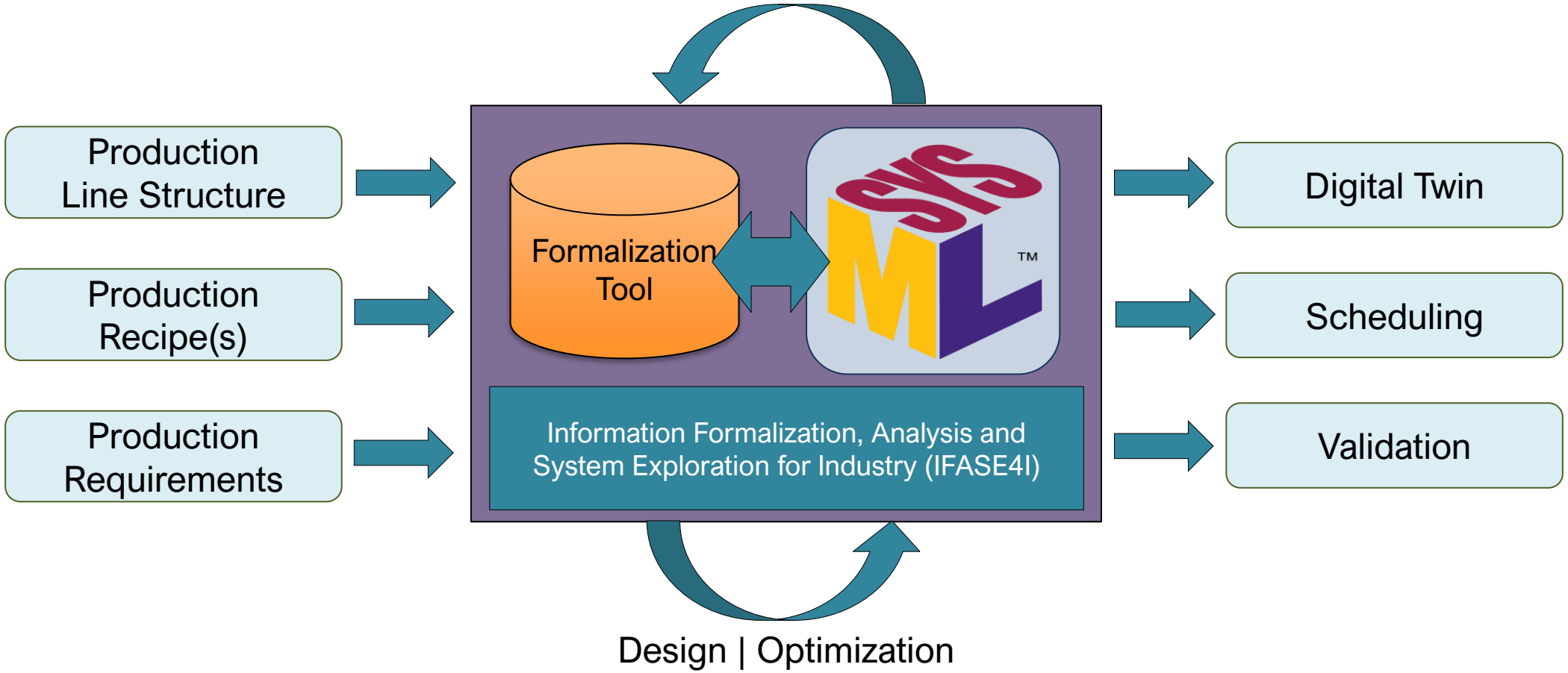
Analysis and Design of CPPSs

Models | A/G Contracts



Design | Optimization

ESD Electronic Systems Design
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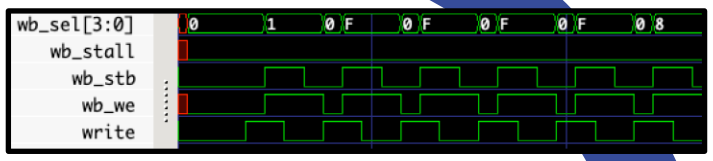
HARM: Hint Based Assertion Miner

Trace



INPUT

User insights

HARM

LTL Assertions

```
G(((v1 && v3) || (v2 && v4)) -> X(v7 > 5))
G({{(v1) ##1 (v2 && v3) ; v4}} |-> X(v6 R v5))
G({{(!v3 && v1) ##1 (v3) ; v4}} |-> X(v6 R v5))
G({{(!v4) ##1 (v3) ; v4}} |-> X(v6 R v5))
G(((v1 && v2) || (v1 && v3)) -> X(v7 > 5))
G(((v1 && v2) || (v1 && v4)) -> X(v7 > 5))
G(((v1 && v3) || (v3 && v4)) -> X(v7 > 5))
G(((v1 && v4) || (v3 && v4)) -> X(v7 > 5))
G(((v2 && v4) || (v3 && v4)) -> X(v7 > 5))
G(((v1 && v2) || (v2 && v4)) -> X(v7 > 5))
```

OUTPUT

ESD Electronic Systems Design
Synthesis Verification Testing Power Communication

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gitlab.com/SamueleGerminiani/harm

OPERA: Collision Prediction for Human-Robot Interaction

By analyzing in **real time** the **history of** (predictable) **robots' state**, it is possible to **deduce** any **possible collisions** in the **future** between any **robot** and any **human:**

- Setup-less: no modeling of the robot is required
- Human/robot bodies as collections of 3d keypoints, with interchangeable modeling of volumes based on accuracy
- Communication using a publisher/subscriber model (MQTT)

FORMAL METHODS for ENGINEERING

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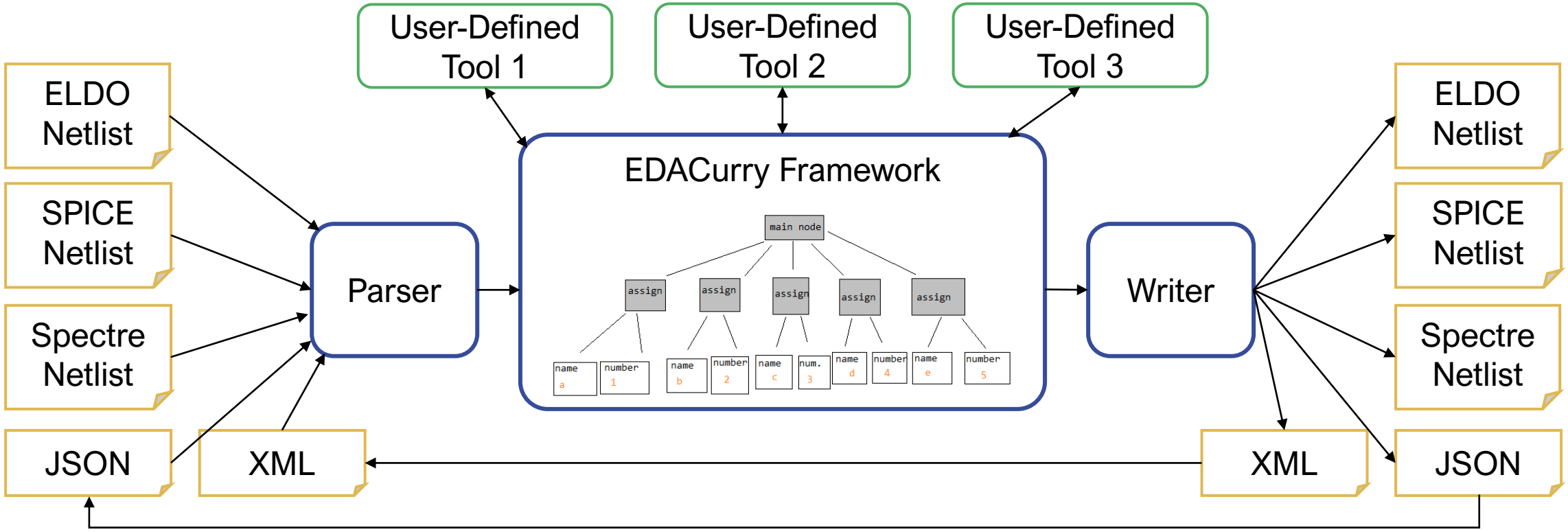
github.com/ariadne-cps/opera

EDACurry

- An **open-source** C++ library for **transistor-level** netlists **manipulation**, with interfaces with **C++** and **Python**



ESD Electronic Systems Design
Synthesis Verification Testing Power Communication

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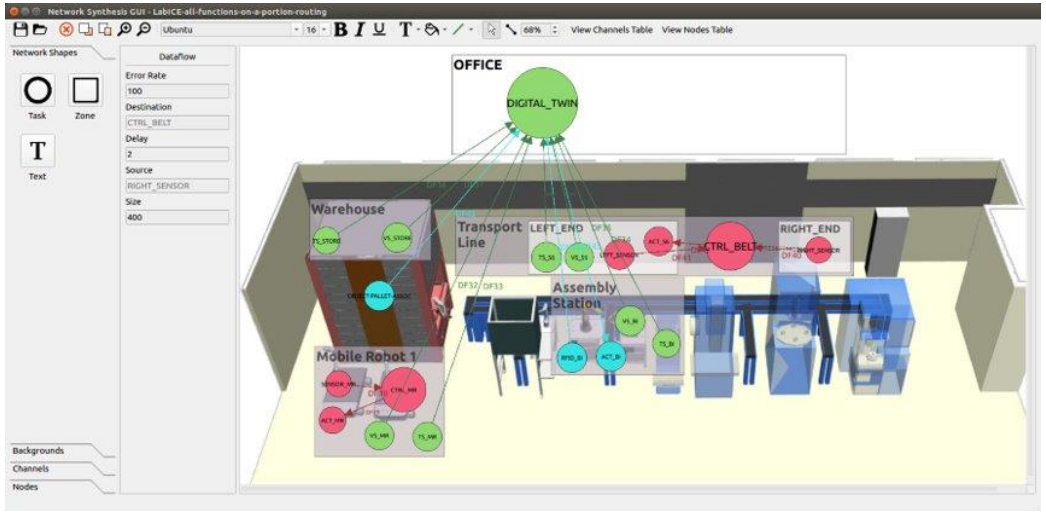
github.com/sydelity-net/EDACurry

Need for communications in smart manufacturing[4]



Tool for the network synthesis of the plant

Synthesize the Network

```
List of activated channels:
    Use 3 channels of type Ethernet
    Use 1 channels of type WiFi
    Use 2 channels of type CAN
Data-Flows allocation:
    Dataflow DF32 inside channel WiFi.1
    Dataflow DF33 inside channel WiFi.1
    Dataflow DF34 inside channel Ethernet.3
    Dataflow DF35 inside channel Ethernet.3
    Dataflow DF36 inside channel Ethernet.1
    Dataflow DF37 inside channel Ethernet.1
    Dataflow DF38 inside channel Ethernet.2
    Dataflow DF39 inside channel Ethernet.2
    Dataflow DF40 inside channel CAN.1
    Dataflow DF41 inside channel CAN.2
    Dataflow DF42 inside channel CAN.2
    Dataflow DF43 inside channel Ethernet.1
    Dataflow DF44 inside channel Ethernet.3
    Dataflow DF45 inside channel Ethernet.3
Economic Cost       : 9031
    2442 (Nodes) + 1201 (Wireless) + 5388 (Channels)
Energy Consumption :  581
    42 (Nodes) + 201 (Wireless) + 338 (Cable)
Total Delay         :  128
    80 (Wireless) + 48 (Cable)
Total Error         :   16
    4 (Wireless) + 12 (Cable)
Elapsed Time : 1.20 s
    File parsing           : 0.02 s
    Structure creation     : 0.12 s
    Constraints definition : 0.63 s
    Optimization           : 0.42 s
```

CATANIS

CAD Tool for **A**utomatic **N**etwork **S**ynthesis

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github.com/Galfurian/NetworkSynthesizer

References

[1] Teren, V., Cortadella, J., Villa, T. (2021). *Decomposition of transitions systems into sets of synchronizing.* 24th Euromicro Conference on Digital System Design (DSD), Palermo, Italy 1-3 Settembre 2021, pp. 77-81

[2] Demrozi, F., Turetta, C., Chiarani, F., Kindt, P. H., & Pravadelli, G. (2021). *Estimating indoor occupancy through low-cost BLE devices,* IEEE Sensors Journal

[3] Turetta C., Demrozi, F., Kindt, H.P., Masrur, A., & Pravadelli, G. (2022, February). *Practical identity recognition using WiFi's Channel State Information*. To appear in 2022 Design, Automation & Test in Europe Conference & Exhibition (DATE)

[4] Dall'Ora, N., Alamin, K., Fraccaroli, E., Poncino, M., Quaglia, D., Vinco, S. (accepted). *Digital Transformation of a Production Line: Network Design, Online Data Collection and Energy Monitoring.* To appear in IEEE Transactions on Emerging Topics in Computing