



ARTIFICIAL INTELLIGENCE IN AUTOMATION TECHNOLOGY

Fraunhofer ESK

15.10.2018

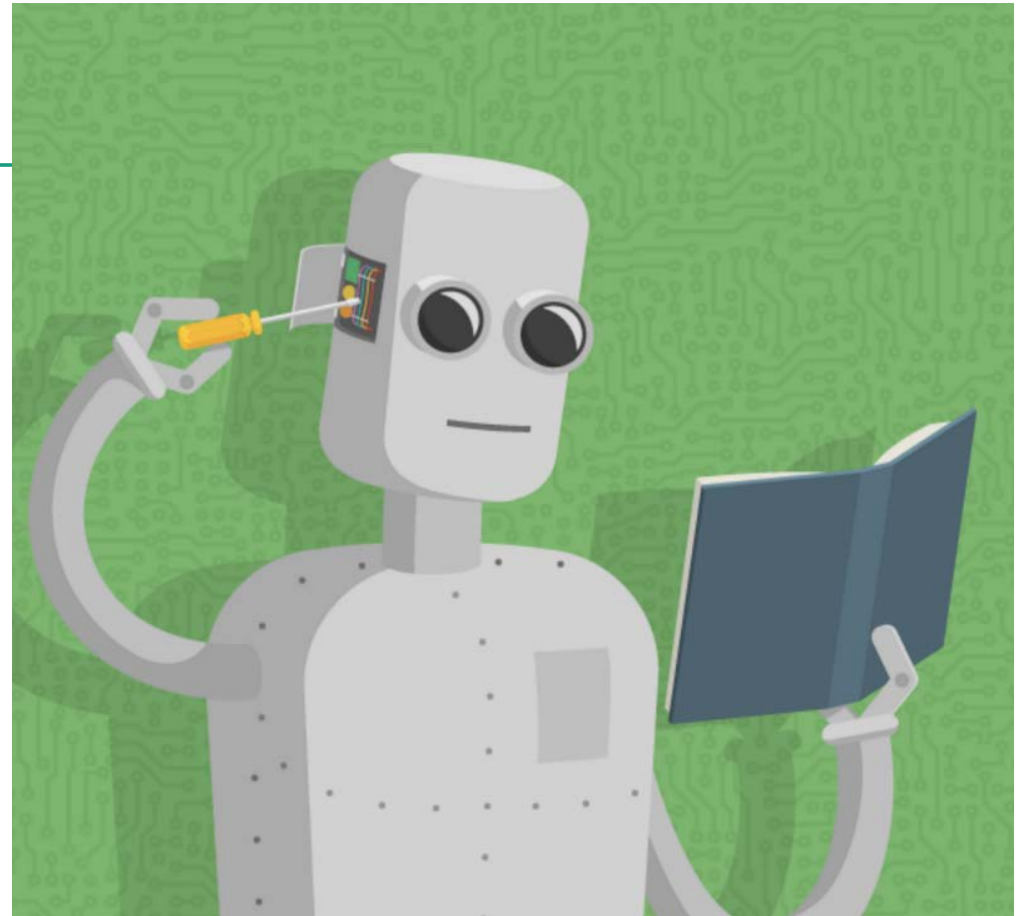
Presenter:-
Aniket Salvi





SEMI-AUTOMATED UNSUPERVISED LEARNING FROM SYSTEM TRACES

Fraunhofer ESK





Applications of AI in Industrial Automation

- Predictive Maintenance
- Fault Detection and Analysis

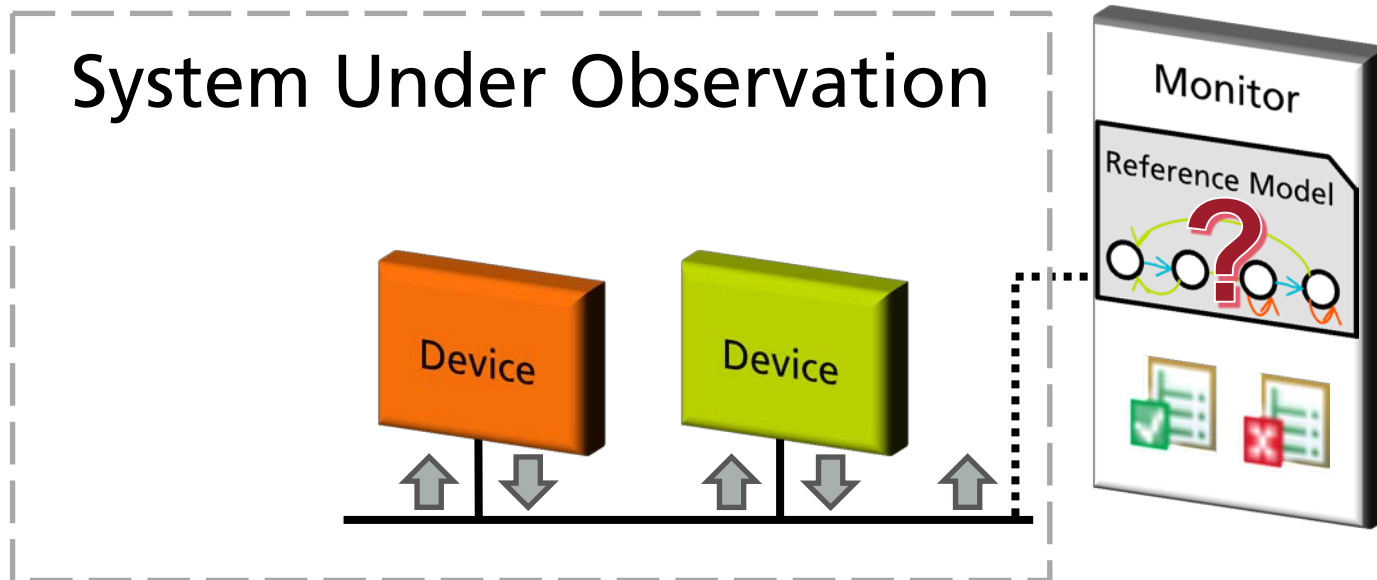


<https://www.einfochips.com/blog/a-5-minute-guide-to-utilizing-predictive-maintenance-in-industrial-automation>



<http://www.omron-ap.co.in/io-link/>

Monitoring & Runtime Verification

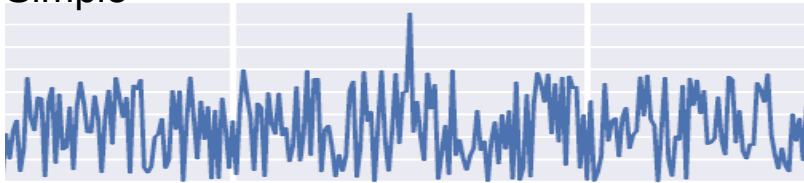


Anomaly Detection

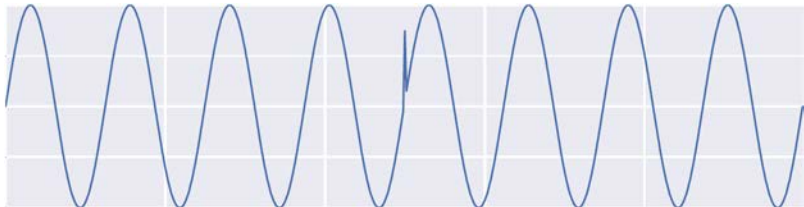
Anomaly type: Time-Series

Point Anamolies

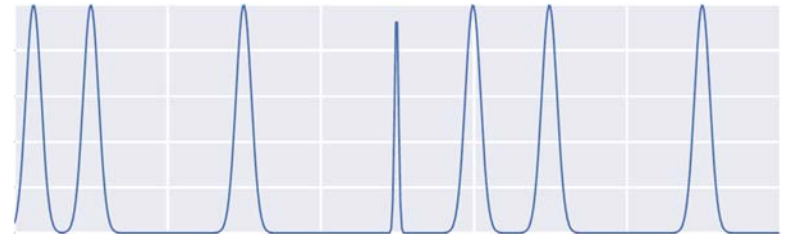
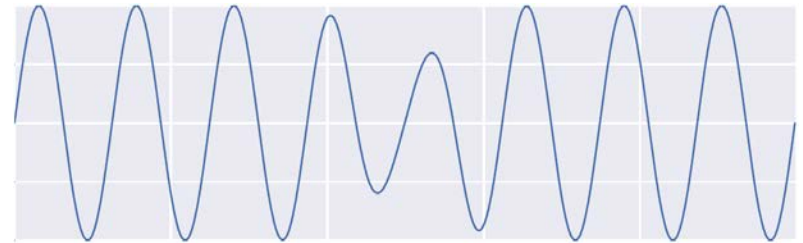
Simple



Context

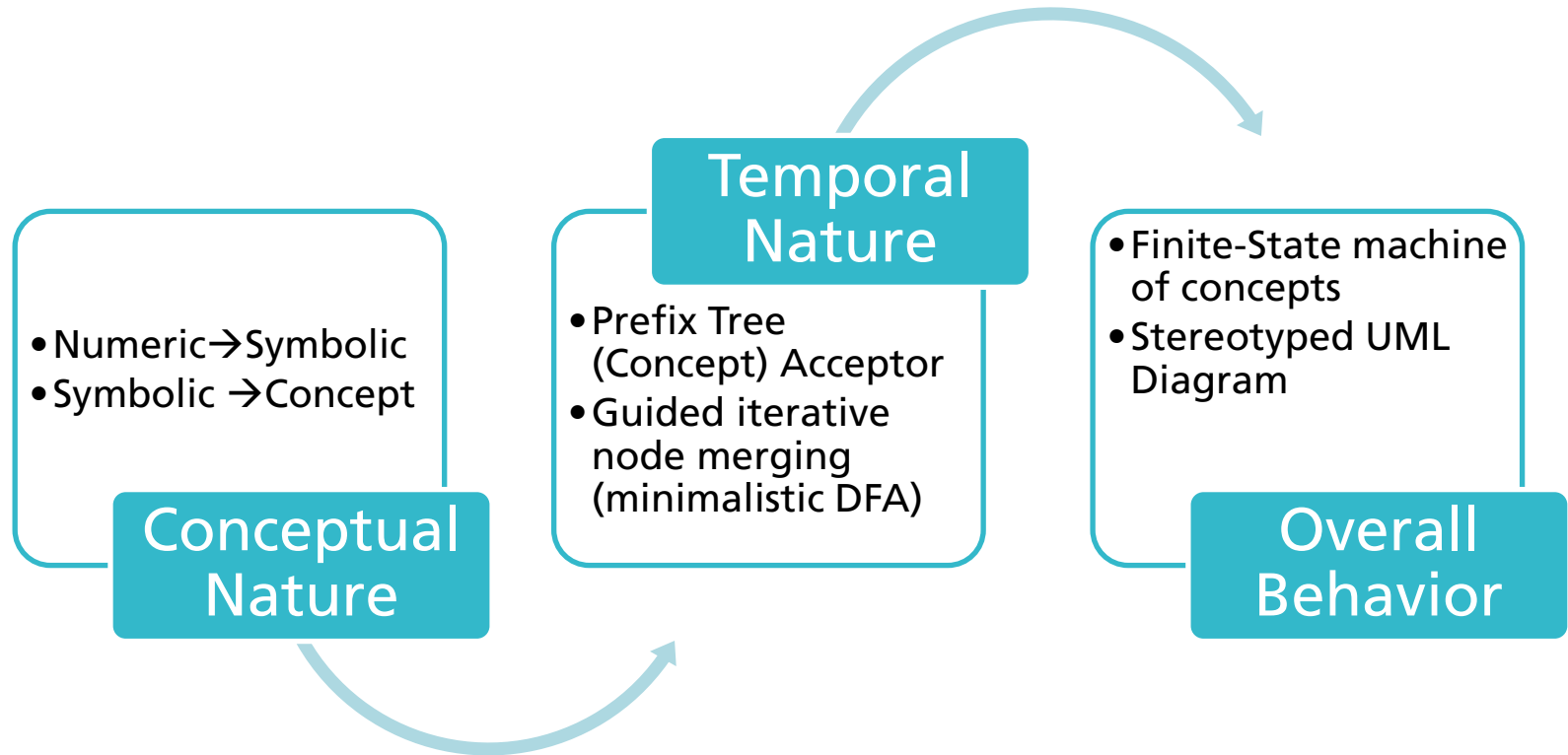


Discord Anamolies

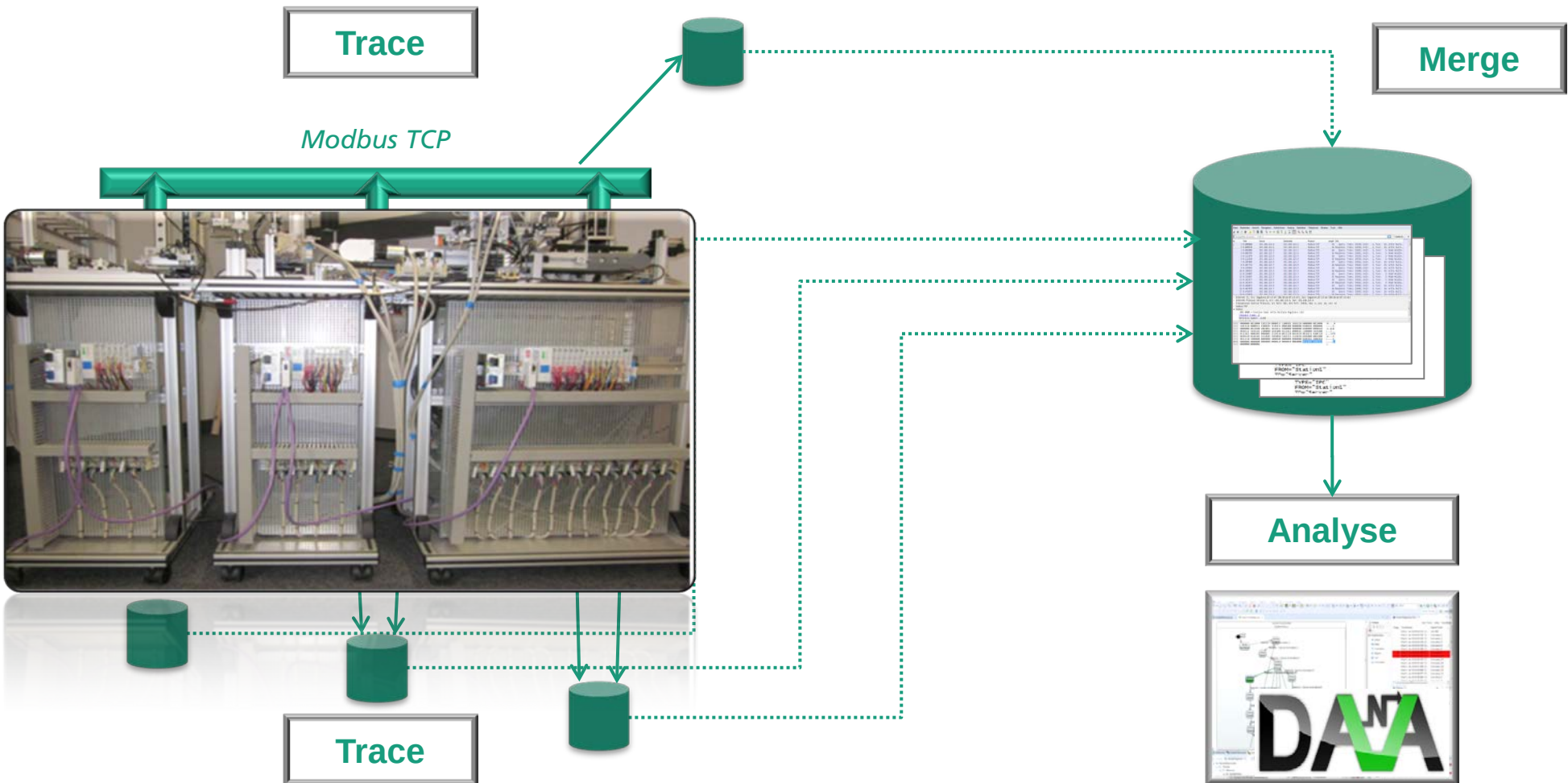


Unsupervised Anomaly Detection in Sequences Using Long Short Term Memory Recurrent Neural Networks, alDosari, Majid S., 2016

Semi-automated behavior learning from traces



Example- Tracing of Model Factory



Screenshot of DANA Tool



The screenshot displays the DANA Tool interface within the Eclipse Platform. The main window shows a state machine diagram for 'AudioManager.di'. The diagram includes states like 'Request', 'Reply', 'Add Max: 10', 'Connecting', 'Connected', 'Disconnecting', 'Disconnected', and 'Remove'. Transitions are labeled with messages such as 'HMI->AudioManager::Connect_First?' and 'AudioManager->HMI::MainConnectionStateChanged_1Disconnected!'. A green box highlights the 'Connecting' state, with an arrow pointing to it from the 'Animation' label.

On the right, the 'Event Mapping View' shows a table of events:

Flags	Timestamp	Signal Event
	Thu 1. Jan 1:00:00.000 C...	init: INIT
S	Thu 12. Mar 10:42:13.900...	Connect_First?
	Thu 12. Mar 10:42:13.911...	Connect_First!
E	Thu 12. Mar 10:42:13.921...	timeout: AudioManager_Models_Beha...
S	Thu 12. Mar 10:42:13.978...	MainConnectionStateChanged_1Conn...
	Thu 12. Mar 10:42:13.978...	MainConnectionStateChanged_1Conne...
	Thu 12. Mar 10:42:13.978...	MainConnectionStateChanged_1Discor...
	Thu 12. Mar 10:42:13.978...	Connect_Second?
	Thu 12. Mar 10:42:13.978...	Connect_Second!
	Thu 12. Mar 10:42:13.978...	NumberOfMainConnectionsChanged!
	Thu 12. Mar 10:42:13.979...	MainConnectionStateChanged_2Conn...

Below the event mapping view, the 'Debug' console shows the state machine 'AudioManager2HMI' (Suspended) and threads 'Thread [AudioManager2HMI]' (Suspended) and 'Thread [AudioManager2HMIRegion1]' (Suspended). A breakpoint is set at 'AudioManager2HMIRegion1.Connecting'. An arrow points to the 'Debug' console from the 'Eclipse Debug Integration' label.

At the bottom, the 'Properties' view shows the 'Model Validation' tab, displaying the 'AudioManager' model's properties: 'Arguments', 'From', 'Interface', 'Method/Attribute', and 'Serial'. An arrow points to this view from the 'Detailed view of message contents' label.

Other labels with arrows pointing to the interface include 'Breakpoints' (pointing to the 'Connecting' state), 'Events, Anomalies and Resumption' (pointing to the event mapping view), and 'State-History' (pointing to the 'Debug' console).

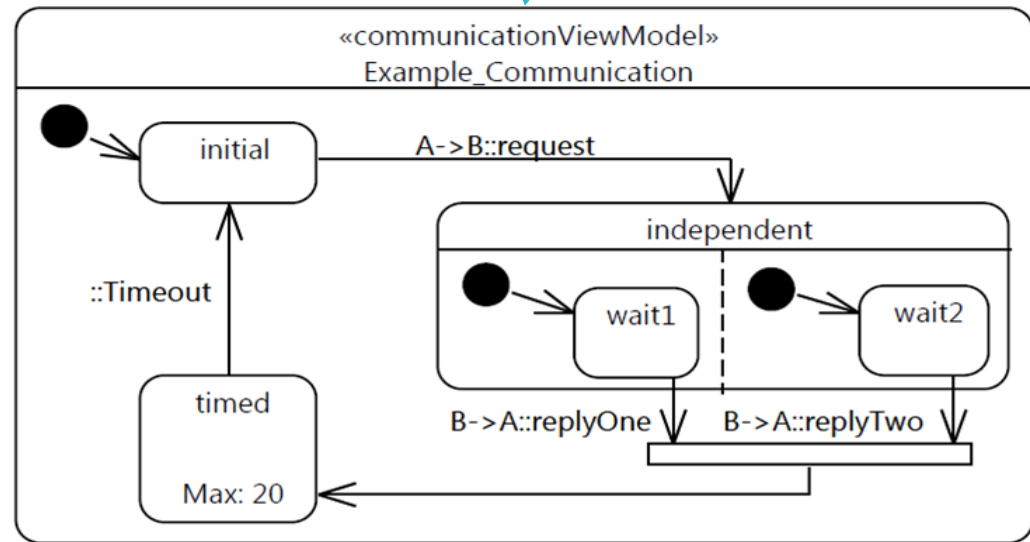
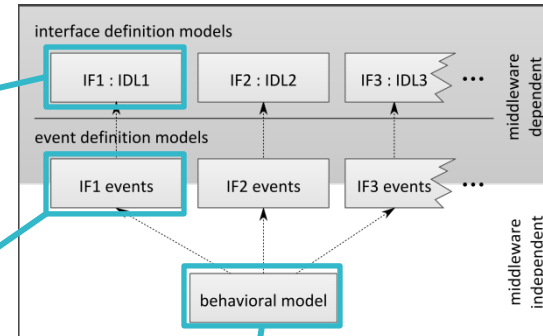
Model-based specification of interfaces

```
interface simple {  
  version {  
    major 1  
    minor 0  
  }  
  method message {  
    out {  
      Int8 id  
    }  
  }  
}
```

interface definition model

```
interface simple {  
  CallEvent request {  
    methodRef message  
  }  
  ResponseEvent replyOne {  
    methodRef message  
    constraint {id == 1}  
  }  
  ResponseEvent replyTwo {  
    methodRef message  
    constraint {id == 2}  
  }  
}
```

event definition model



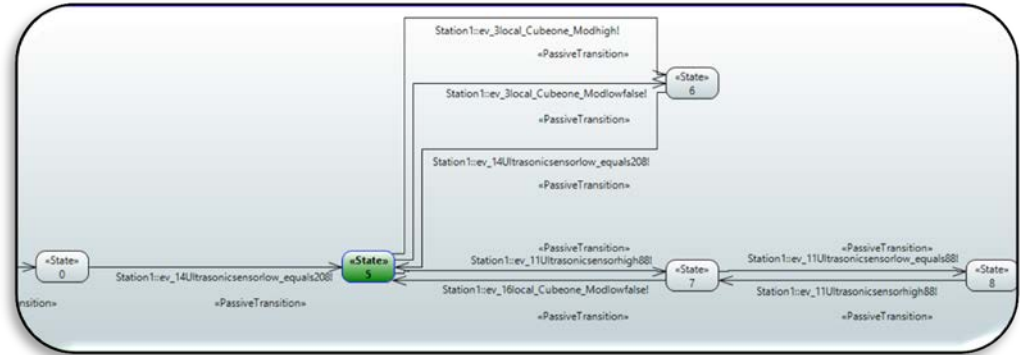
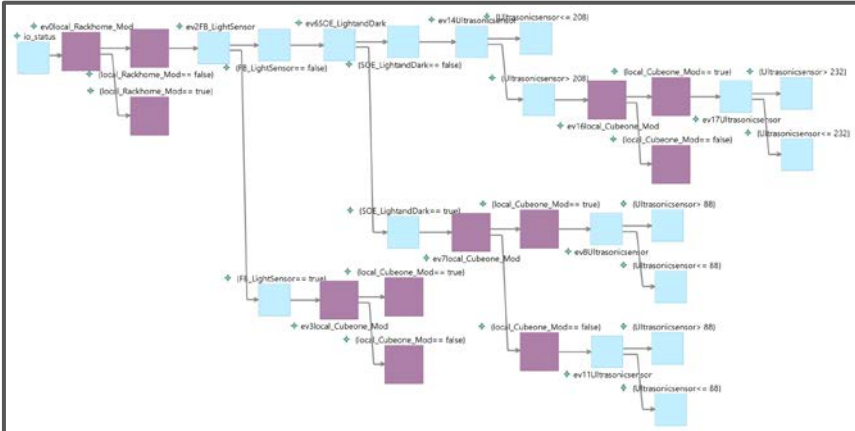
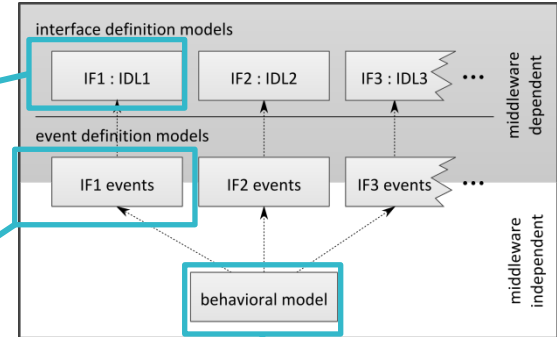
behavioral model

Example Use Case: Generated Model

```
package test

interface Station1 {

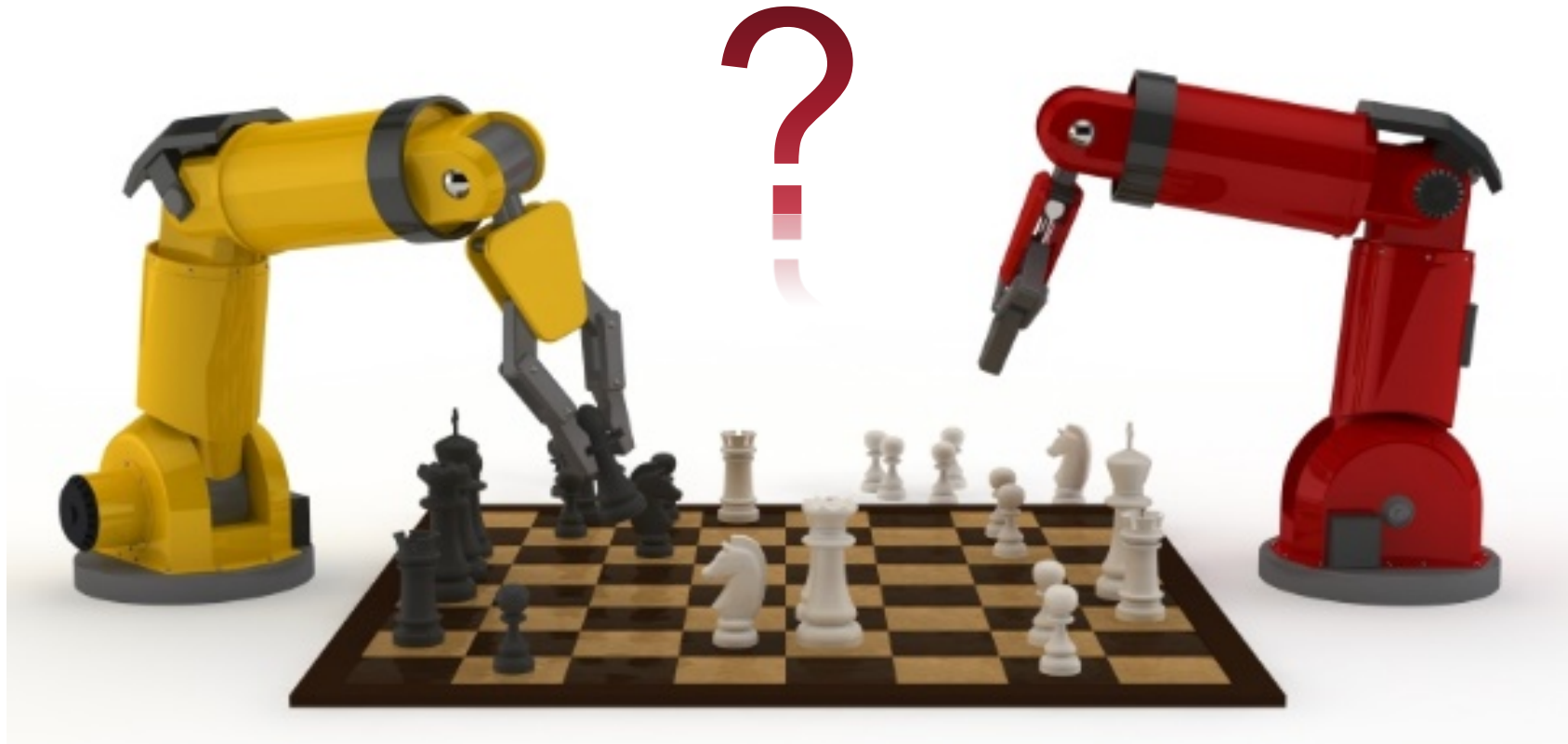
broadcast io_status{
out{
    Boolean FB_LightSensor
    Boolean FB_MotorAnticlockwise
    Boolean SOE_Lightanddark
    Double Ultrasonicsensor
    }
}
}
```



Industry Use-case: Robot Pickup



Thank You for your Attention!



<https://robotnor.no/expertise/fields-of-competence/robot-learning/>