communication simulation with agents

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Who are we?

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OFFIS – Institute for Information Technology

> State-funded Research Institute in Oldenburg, Germany (founded in 1991)
> 250 Scientist in 4 R&D Divisions (Energy, Health, Manufacturing, Society)
> Energy Informatics at OFFIS & UOL
> 2022: ~30 ongoing research projects
> Largest EI team in D/EU (>100 researchers)

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Communication Use Cases in Energy Informatics

- Create MAS robust to failures
- Consider the interaction between power and communication system
- Optimize the communication flow for multiple smart grid applications
Simulation Environment

So far, perfect communication conditions are assumed. Communication impairments can only be considered in an oversimplified model (e.g., static latency).

Robustness of (fully distributed) control algorithms must be evaluated under more realistic communication scenarios.
Co-simulation framework mosaik

Main Features

• Combine available simulation tools from different domains
• Specification of simulation scenarios
• Coordination of data exchange and scheduling

Open source (LGPL) [https://gitlab.com/mosaik](https://gitlab.com/mosaik)
mosaic ecosystem: lots of existing simulation models
  • [https://gitlab.com/midas-mosaic/midas](https://gitlab.com/midas-mosaic/midas)
  • [https://gitlab.com/mosaik/components](https://gitlab.com/mosaik/components)
Mosaik 3.0.0.: Discrete Event Capabilities


Event-based (coming with mosaik 3.0.0)

> Max_advance value
  > Information how far a simulator can advance in time without expecting new inputs
  > Simulator can progress until max_advance without being interrupted by mosaik and risking causality errors
Integration of communication simulation
General Architecture

1) Message from client0 to client1 at time $t_1$

2) Message to client1

3) Insert message into FES

4) Simulation of message dispatch

5) Confirmation of receipt of the message

6) Message to client1 with current simulation time $t_2$

7) Message to client1 in time $t_2$

Agent client0: mosaik simulator

Communication-Simulator: mosaik simulator

Agent client1: mosaik simulator

MosaikScheduler: cScheduler

AgentApp client0: cSimpleModule

AgentApp client1: cSimpleModule

OMNeT++ simulation time

Mosaik simulation time
Synchronisation between mosaik and OMNeT++

client0: AgentSimulator

client1: AgentSimulator

Communication-Simulator

mosaik

MosaikScheduler

max_advance = 5

max_advance = 14

message client0 -> client1

message client1 -> client0

simulation
step(time=0, inputs=message*: "Hi client1", max_advance=20)

[if it is the first message]

send_initial_message(sim_time)

handleMsgFromMosaik()

[if messages to send]

send_message_to_omnetpp(messages="Hi client1")

handleMsgFromMosaik()

getSimulation()->getFES()->insert("Hi client1")

handleMessageWhenUp("Hi client1")

sendReply("Hi client1")

delay = 15ms

receive_messages_from_omnetpp(time=0, max_advance=20, messages_sent=True)

send_reply_over_TCP_socket

* A message contains other meta-information, such as the sender and receiver, but is shown here in a simplified form.
Features

- Start modes using IDE or compiled executables (Qtenv or cmd)
- Adjust the number of agents
- Apply infrastructure changes (dis- and reconnects of clients, routers and switches) during simulation
- Connect PV plant simulators to agent(s)
- Multiple exemplary OMNeT++ networks
- Overview of the simulation based on collected information
  - e.g., number of simulation steps and evaluation graphs
> How to configure scenarios:
  > Number of agents
  > Network
  > Disconnects, Reconnects
  > PV device
  > ..

> How to start a scenario?
Further Information

> cosima.offis.de

> https://cosima.readthedocs.io

> https://gitlab.com/mosaik/examples/cosima

> Coupling OMNeT++ and mosaik for integrated Co-Simulation of ICT-reliant Smart Grids.

https://doi.org/10.48550/arXiv.2209.12550


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