IES

Integrated Energy Systems

Dynamic Reliability Analysis Framework and Toolbox

Time-dependent Reliability Analysis of IESs

Integrated Energy Systems (IES) Tools
FORCE Overview and Training

April 6, 2023

Askin Guler Yigitoglu

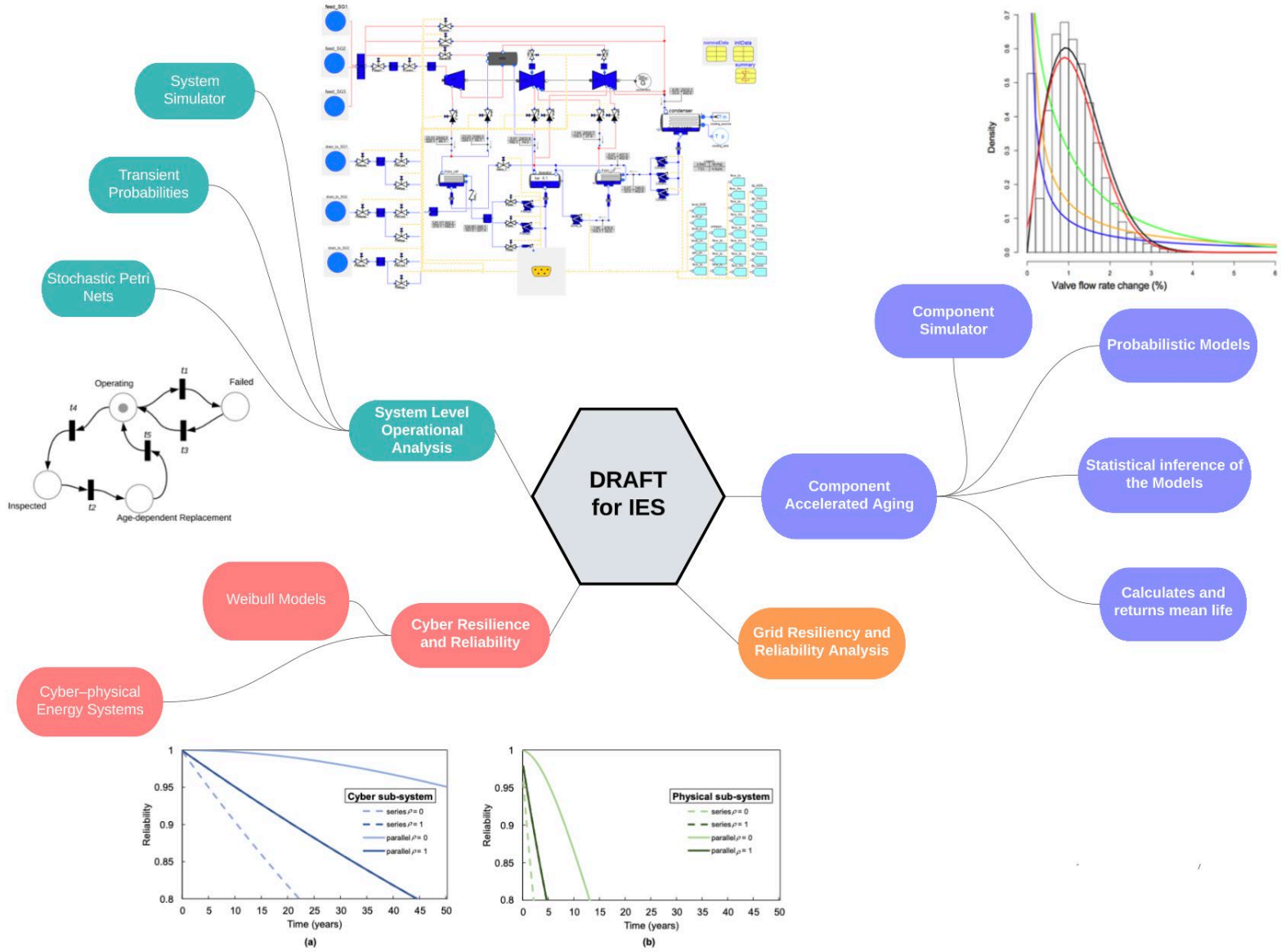
Samantha Sabatino

Oak Ridge National Laboratory

DRAFT is a Reliability Tracker for the IES

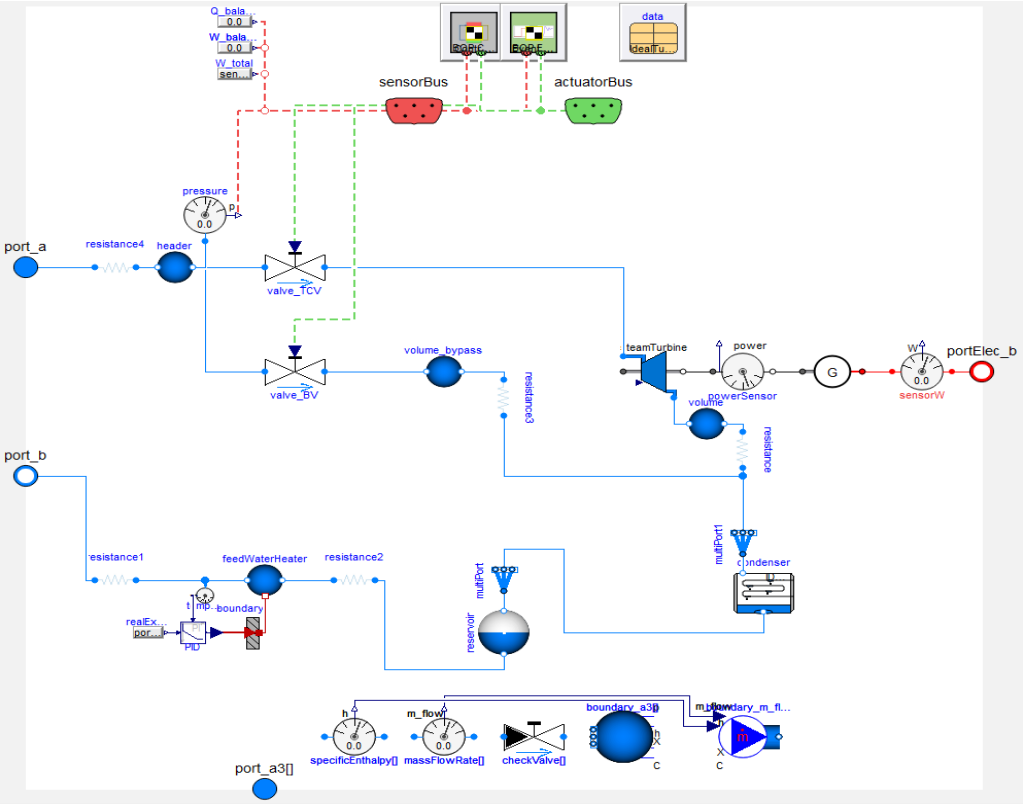
(i) tracks the simulated condition of a component/system to identify its departures from normal operation
(ii) updates the change in failure rates at each time step
(iii) maps these rates as optimum maintenance cost into HERON

DRAFT modules:
- Accelerated Aging
- System SPN
- Cyber–physical Power Systems

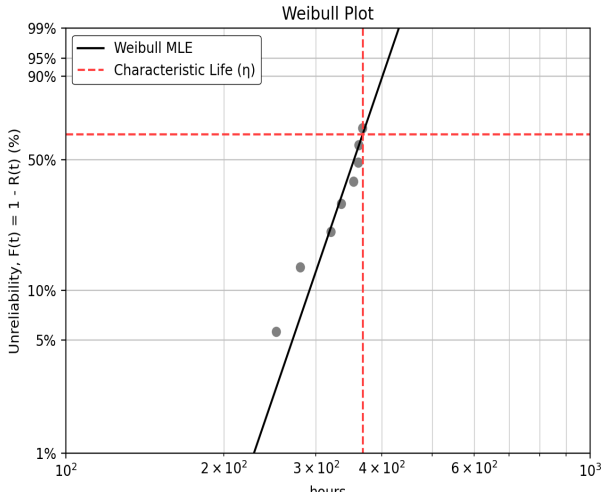


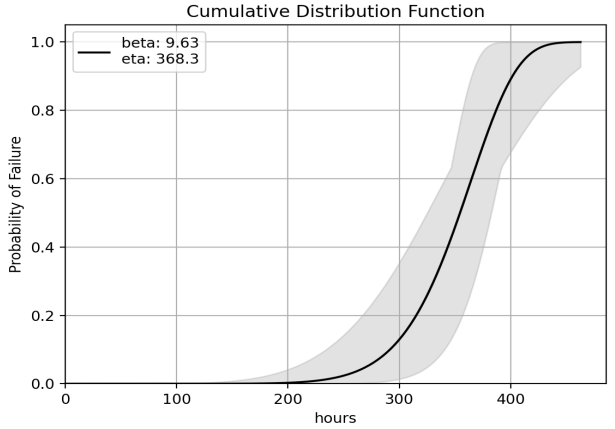
Component Reliability Tracking

The differences between the fixed and Weibull distributed curves illustrate the advantage of tracking the actual age of the component.

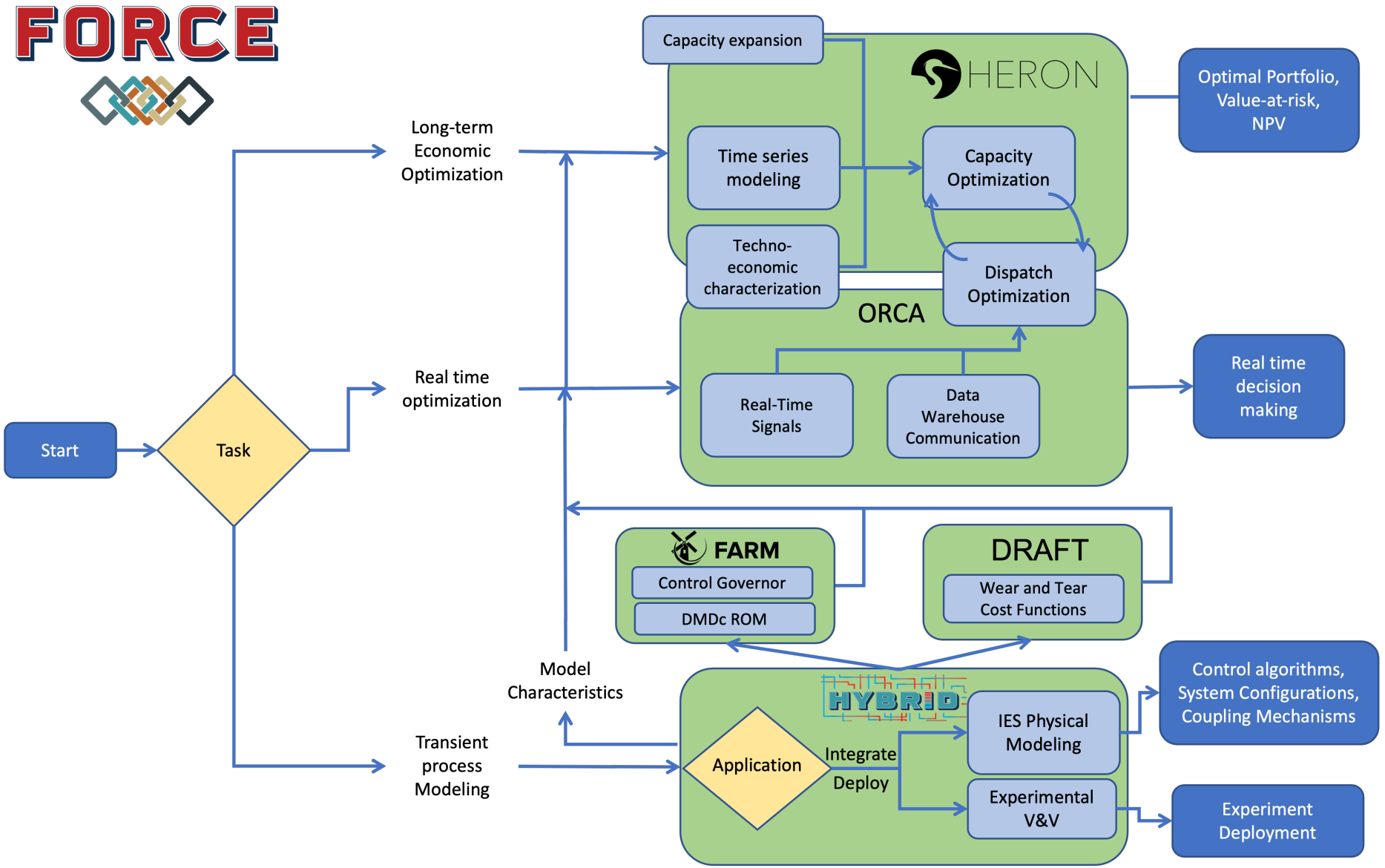


fail_time	is suspended
252	FALSE
280	FALSE
320	FALSE
328	TRUE
335	FALSE
354	FALSE
361	FALSE
362	FALSE
368	FALSE
375	TRUE
375	TRUE
375	TRUE





Reliability Models Integration



Current Status: System Reliability and Interaction

Where is repo? https://code.ornl.gov/ayk/reliability-models

DRAFT is an external model to RAVEN (to be open sourced):

- ➢ the equipment operating limits and
- ➢ system simulations to capture dynamic system response are required.

Component Reliability Module Status:

- ✓ Stand alone code with the data available for testing
- ✓ HERON interface is under development

Subsystem and System Reliability Module Status:

- ✓ Stand alone python code with the TRANSFORM model available for testing

CPS reliability Module is available

Name	Last commit
data	Add initial reliability models
doc	Add initial reliability models
src	CPS reliability
tests	Add initial reliability models
.gitignore	Add initial reliability models
README.md	Update README.md

SystemModule	Add initial reliability models
AcceleratedAgingModel.py	Add initial reliability models
CPS_reliability.py	CPS reliability
README	Add initial reliability models
aging.py	Add initial reliability models

IES Integrated Energy Systems

Next Steps: Capability Demonstrations

- Thermal Energy Storage (TES)
  - Model within the IES HYBRID Repository
  - Simulations showcase the abilities of each technology to cyclically charge and discharge when exposed to time-varying boundary conditions.
  - Two-tank molten-salt system and the concrete systems were selected for demonstration of the overall reliability and TEAL Cashflow modules.
- Demonstrates
  - Cashflow calculations by TEAL
  - Generate ROMs of system models (TRANSFORM models with RAVEN)
  - Reliability-informed cost optimization with HERON

IES
Integrated Energy Systems

Thank you!

OAK RIDGE National Laboratory

Askin Guler Yigitoglu
Reactor Systems Modeling and Safety Analysis Staff Member
Reactor Safety & Licensing Team, Advanced Reactor Engineering
Reactor & Nuclear Systems Division

(865) 574-6130
(614) 530-9551 cell
yigitoglua@ornl.gov

One Bethel Valley Road
P.O. Box 2008, MS-6170
Oak Ridge, TN 37831-6170

IES
Integrated Energy Systems