Modelado y gestión dinámica de la variabilidad en sistemas robóticos

Cristina Vicente-Chicote (Universidad de Extremadura, Spain)

cristinav@unex.es

Juan F. Inglés-Romero (Biometric Vox, Spain)

juanfran.ingles@biometricvox.com

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What are MIRoN and RoQME about?

RoQME and MIRoN are Integrated Technical Projects funded by the RobMoSys **H2020 Project** (G.A. 732410)

MIRoN **provides a component-based and model-driven framework enabling adaptive robot navigation** by dynamically reconfiguring the robot behavior, defined in terms of Behavior Trees (BT), according to the runtime estimation of QoS metrics defined on relevant Non-Functional Properties (NFPs). These metrics are provided by a RoQME component...

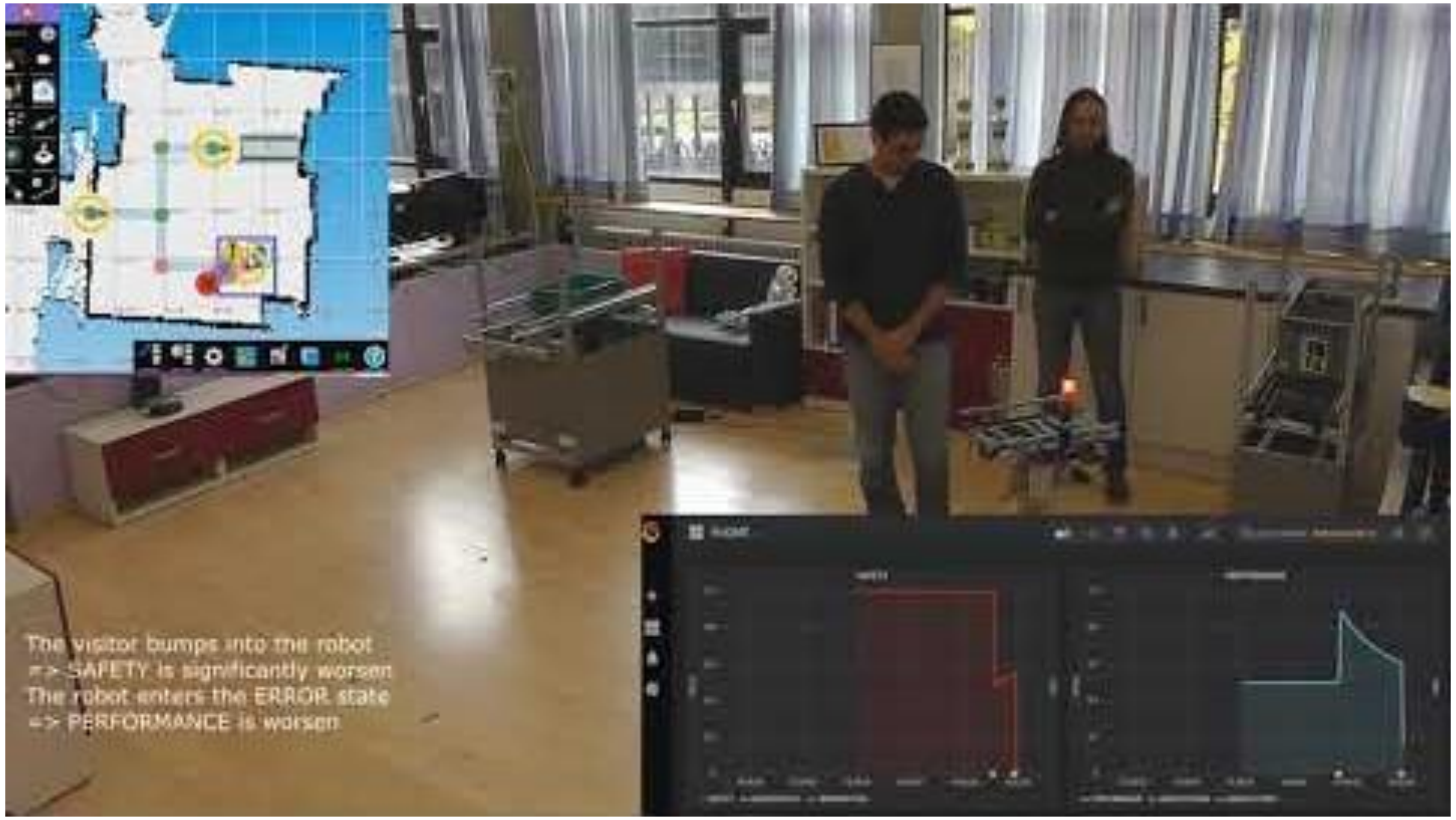
RoQME **allows specifying relevant NFPs** (e.g., safety, performance, resource consumption, user engagement, etc.) **and how certain situations affect them**. The RoQME models allow designers to explicate these concepts in a qualitative (rather than a quantitative) way. Then, from these specifications, the RoQME Toolchain generates and configures a complete runtime infrastructure, including:

1) appropriate **Context Monitors** (CM);
2) a **Complex Event Processor** (CEP), aimed at identifying relevant context patterns (situations); and
3) a **Bayesian Network** (BN), aimed at estimating the NFPs being considered according to the identified situations. It is worth noting that the BN component....
   - ... provides a QoS metric (in the range [0, 1]) for each NFP, indicating to what extent it is optimal.
   - ... deals with the complexity of adjusting the quantitative aspects of the RoQME models.

Modeling QoS metrics with RoQME

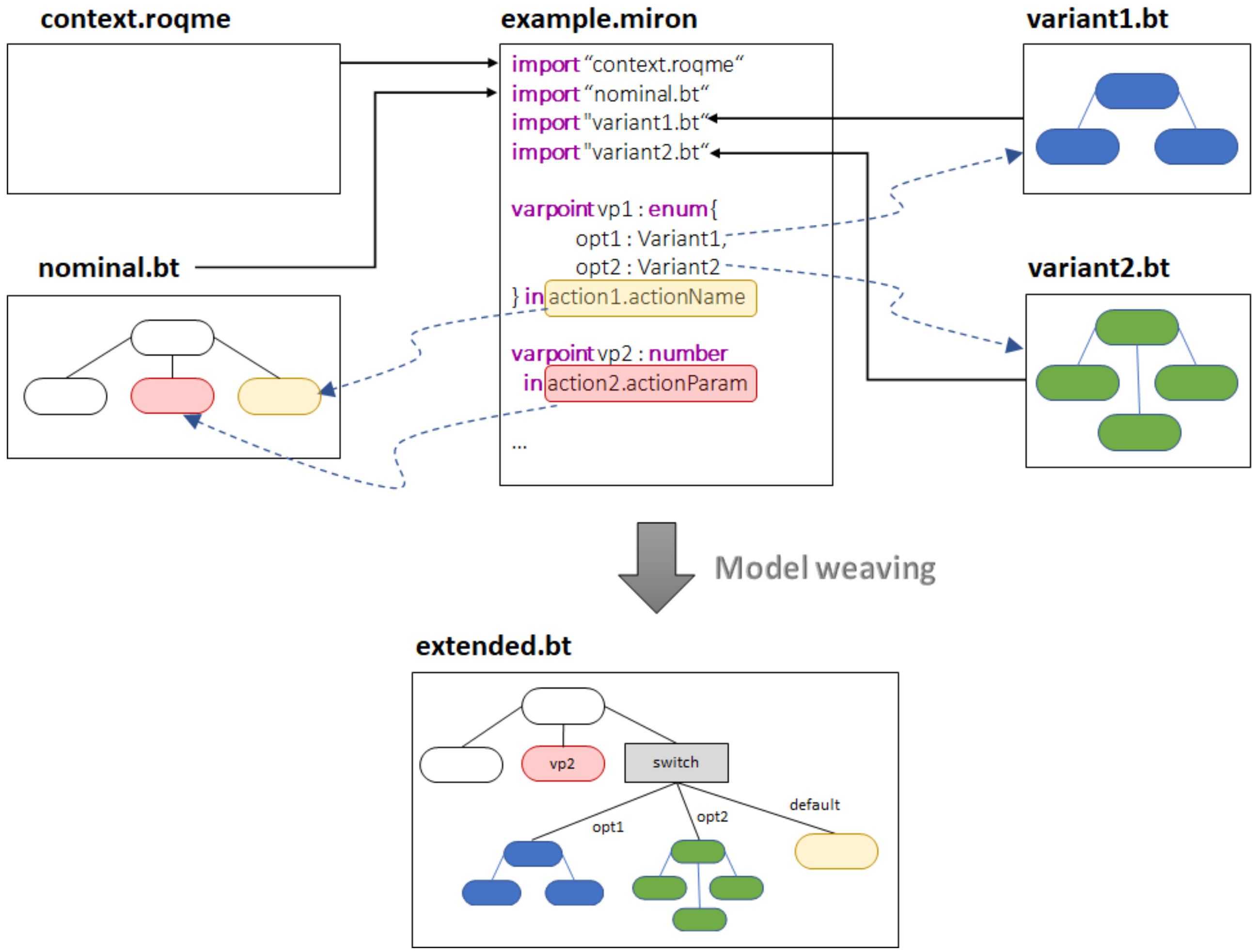
```
property Safety reference 1
property Performance reference 0.5

context Bump : eventtype
context Velocity : number
context PersonState : boolean
context JobState : enum {NOT_STARTED, STARTED, COMPLETED, ABORTED}
context RobotState : enum {IDLE, CHARGING, DRIVING_WITH_LOAD, DRIVING_EMPTY, ERROR }
context TimeJobDone : time := period (JobState::STARTED -> JobState::COMPLETED)

observation O1 : Bump undermines Safety VERY_HIGH
observation O2 : Velocity > MAX_V & PersonState  undermines Safety VERY_HIGH
observation O3 : JobState::COMPLETED while(TimeJobDone<AVG_JOB) reinforces Performance HIGH
observation O4 : RobotState::ERROR undermines Performance
observation O5 : JobState::ABORTED undermines Performance
```

RoQME in action


The visitor bumps into the robot
=> SAFETY is significantly worsen
The robot enters the ERROR state
=> PERFORMANCE is worsen

https://robmosys.eu/wiki/community:roqme-intralog-scenario:start

Modeling behaviour adaptation with MIRoN

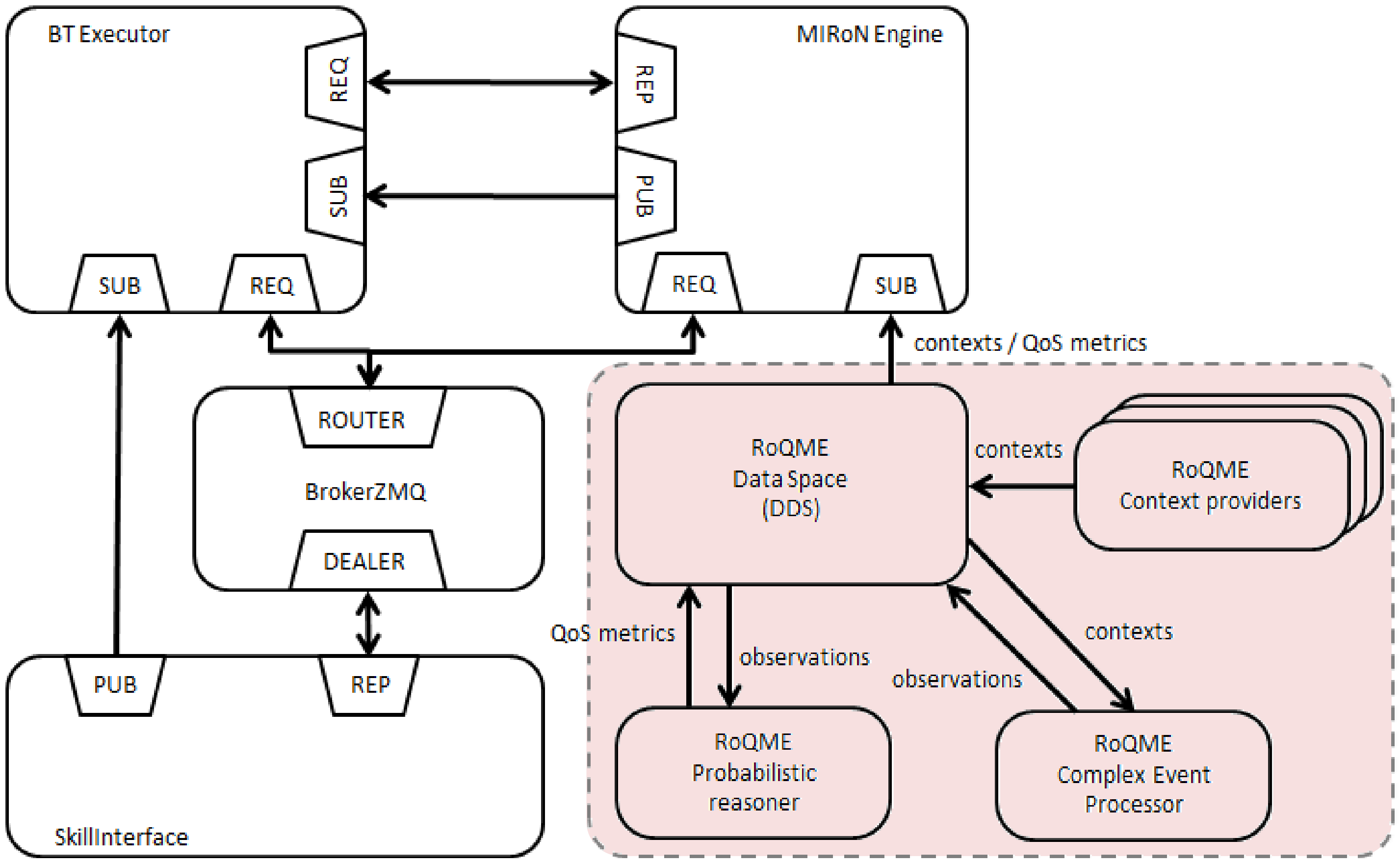


```
import "context.roqme"
import "nominal.bt"
import "variant1.bt"
import "variant2.bt"

varpoint vp1 : enum{
        opt1 : Variant1,
        opt2 : Variant2
} in action1.actionName

varpoint vp2 : number
  in action2.actionParam

...
```

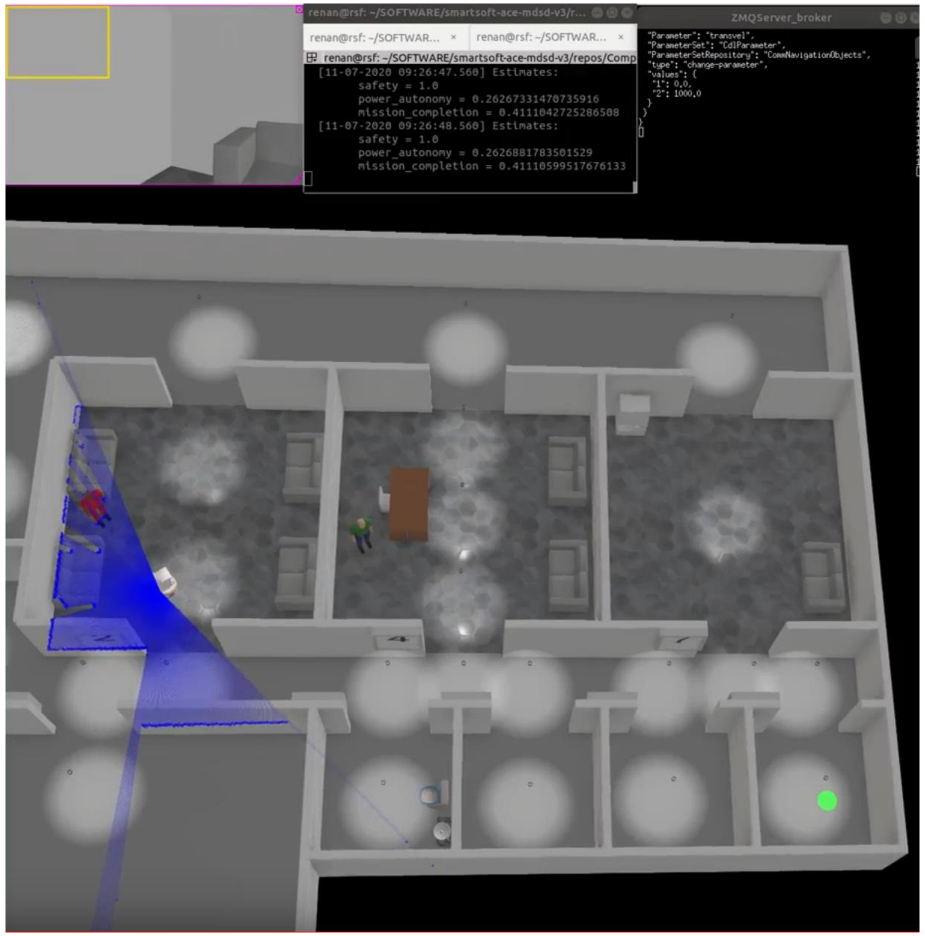
Modeling behaviour adaptation with MIRoN

```
import "base.bt" as main
import "variants.bt"
import "test.roqme" as roqme

varpoint goto_strategy : enum {
        opt1 : Variant1 affects { roqme.Performance+ },
        opt2 : Variant2 affects { roqme.Safety+ }
}
in main.action1


varpoint max_velocity : number lower 10 upper 100 {
        10 affects {roqme.Performance-, roqme.Safety+},
        100 affects {roqme.Performance+, roqme.Safety-}
}
in main.action2.velocity

rule r1 : roqme.Bump implies max_velocity = 10
```

The RoQME + MIRoN runtime infrastructure

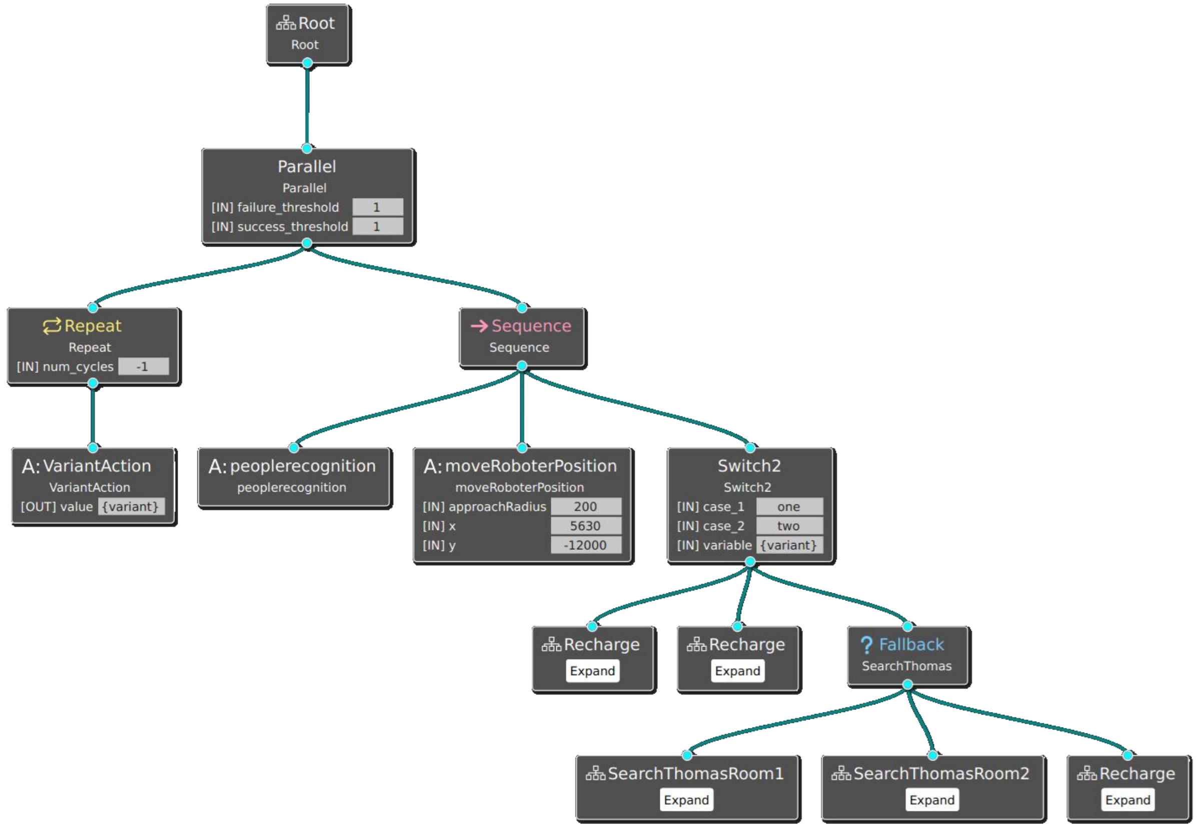


RoQME + MIRoN in action



```
renan@rsf: ~/SOFTWARE/smartsoft-ace-mdsd-v3/repos/Comp
 [11-07-2020 09:26:47.560] Estimates:
        safety = 1.0
        power_autonomy = 0.262673314707359l6
        mission_completion = 0.411104272528650 8
 [11-07-2020 09:26:48.560] Estimates:
        safety = 1.0
        power_autonomy = 0.2626881783501529
        mission_completion = 0.4111059951767613 3
```

```
ZMQServer_broker
 "Parameter": "transvel",
 "ParameterSet": "CdlParameter",
 "ParameterSetRepository": "CommNavigationObjects",
 "type": "change-parameter",
 "values": {
  "1": 0.0,
  "2": 1000.0
 }
}
}
```



Gracias!

@RoQME_ITP (https://twitter.com/roqme_itp)

@MIRoN_ITP (https://twitter.com/miron_itp)

https://github.com/roqme/
https://github.com/MiRON-project/