Model Driven Software Development in Service Robotics – *It really works!*

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http://www.zafh-servicerobotik.de/ULM/index.php
http://www.hs-ulm.de/schlegel
http://smart-robotics.sourceforge.net/

Model Driven Software Development
Example / Navigation Task

DeployNavTask

NamingService

SmartRobotConsole

cdlGoalEventClient
cdlParameterClient
cdlStateClient

plannerEventClient
plannerParameterClient
plannerStateClient

mapperParameterClient
mapperStateClient

SmartCdlIServer

navVelSendClient
laserClient
plannerClient

goalEventServer
paramServer
stateServer

SmartPioneerBaseServer

navigationVelocityServer
basePositionServer

SmartLaserServer

baseClient
laserServer

SmartMapperGridMap

curPushServer
paramServer
stateServer

SmartPlannerBreadthFirstSearch

baseClient
curMapClient

plannerGoalServer
plannerEventServer
paramServer
stateServer

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EURON / Schlegel, Steck
Illustration of our development process

- UML 2.0 profile for robotics component model
- covers component development, system composition, deployment
- based on standards: UML 2.0, Open Architecture Ware, Eclipse, etc.
- different runtime platforms, middleware systems etc.
Engineering the software development process in robotics is one of the basic necessities towards industrial-strength service robotic systems.

Benefits of our development process:
- get rid of hand-crafted single unit service robot systems
- compose them out of standard components with explicitly stated properties
- be able to reuse / modify solutions expressed at a model level
- take advantage from the knowledge of software engineers that is encoded in the code transformators
- be able to verify properties (or at least provide conformance checks)
- be able to address resource awareness!!

and many many more good reasons
Experience made with our development process

- Systematically handle integration of systems of the complexity of service robots and to overcome plumbing
- Tools like OpenArchitectureWare, Eclipse etc. are matured enough to be used in robotics
- There are many experienced people out there being already familiar with the tools, can start immediately using them and can just focus on robotics
- Design patterns, best practices, approved solutions can be made available within the code generators such that even novices can immediately take advantage from that coded and immense experience
- Provides the perfect granularity for system design, component development, composability, freedom within components, tool support etc.
Model Driven Software Development
Examples / Simulation Player/Stage
Model Driven Software Development
Examples / SmartMDSD / Real-Time Task

<<enumeration>>
SchedPolicyKind
FIFO
round-robin
sporadic

<<metaelement>>
SmartTask
schedPolicy : SchedPolicyKind
isRealtime : Boolean
isPeriodic : Boolean
priority : Integer
timeUnit : TimeUnitType
period : Integer
wcet : Integer

<<metaelement>>
SmartCorbaTask
schedPolicy : SchedPolicyKind
isPeriodic : Boolean
priority : Integer
period : Integer

<<metaelement>>
SmartCorbaCondMutex
condMutex [0..1]

<<metaelement>>
SmartCorbaTimer
period : Integer

<<metaelement>>
RTAITask
schedPolicy : SchedPolicyKind
isPeriodic : Boolean
priority : Integer
period : Integer
wcet : Integer

isRealtime == false

isRealtime == true

timer [0..1]
isPeriodic == true

mutex [1]
Model Driven Software Development
Examples / Robocup@Home / “FollowMe”
Model Driven Software Development
Examples / Robocup@Home / “WhoIsWho”
Model Driven Software Development
Metamodels (partial view)
Toolchain based on Open Architecture Ware
- fully integrated into Eclipse
- [http://www.openarchitectureware.org/](http://www.openarchitectureware.org/)

MDSD Toolchain Example
- PIM: SmartMARS robotics profile (Modeling and Analysis of Robotics Systems)
- PSM: SmartSoft in different implementations but with the same semantics!
- can be easily adapted to different profiles / profile extensions / PSMs

Short Summary on SmartSoft [LGPL]
- CORBA (ACE/TAO) based SmartSoft
  – on sourceforge with various robotics components and simulators etc.
  – in use in research and industry
- ACE (without CORBA) based SmartSoft
  – on sourceforge [Linux, Windows]
  – in use in research and industry
- oAW Toolchain for SmartSoft
  – on sourceforge *(including Screencasts and Tutorials)*