A Metamodel Approach to Model Driven Service Development

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Outline

Presenter

- Name: Yngve Lamo
- Bergen University College, Norway
- James Chair, visiting professor at St. FX University, Antigonish, Canada
- Background in formal methods
- Currently working on foundations of model driven software engineering

Introduction

- Norwegian economy is based on:
  - Natural resources, oil and gas, fishing (fish farming), hydro electric power, ...
  - Shipping: an important industry with long traditions in Norway
- Norwegian oil and gas production
  - Offshore production in heavy weather conditions
  - Supply and service industry: mainly done by Norwegian companies
- Safety is highly important
  - Need for training to handle extreme conditions
  - Use of offshore training simulators

Training simulators

- Offshore Simulator Centre (OSC): a Norwegian company which:
  - Delivers offshore simulators
  - Develops training concepts
  - Aims to increase safety for personnel involved in demanding offshore operations
  - See `http://offsim.no`
- MUMS project
  - Model Driven Development of Maritime Simulators
  - Incubation project founded by the Research Council of Norway
  - Cooperation between industry (OSC, RUnit), and University Colleges (HiALS, HiB)

Anchor handling

- The process of placing oil rigs in its right position
- Considered the most dangerous offshore operation

Problem Description

- Offshore simulators should be as realistic as possible, i.e. the crew should get the feeling of working on their own boat
- If a minor detail on a ship is changed the behavior of the ship may be completely different and
- The simulator code needs to be reimplemented
  - Repeated coding of low level details
  - Need to do language specific development (float, int,. . .)
- Our proposal is to use model driven engineering combined with service orientation to tackle the problem

Solution

1. Design domain specific language for the maritime domain
   - Simulator developers can work with domain concepts instead of programming language concepts
2. Components as services:
   - Loose coupling between components
   - Isolate components in specific services
   - SMODL language `http://smodl.org`, language for model driven development of services
3. Code generation
   - Automate the development of simulator code
   - Challenge to automate code for physical behavior of the ship
     - Especially for the differential equation solvers

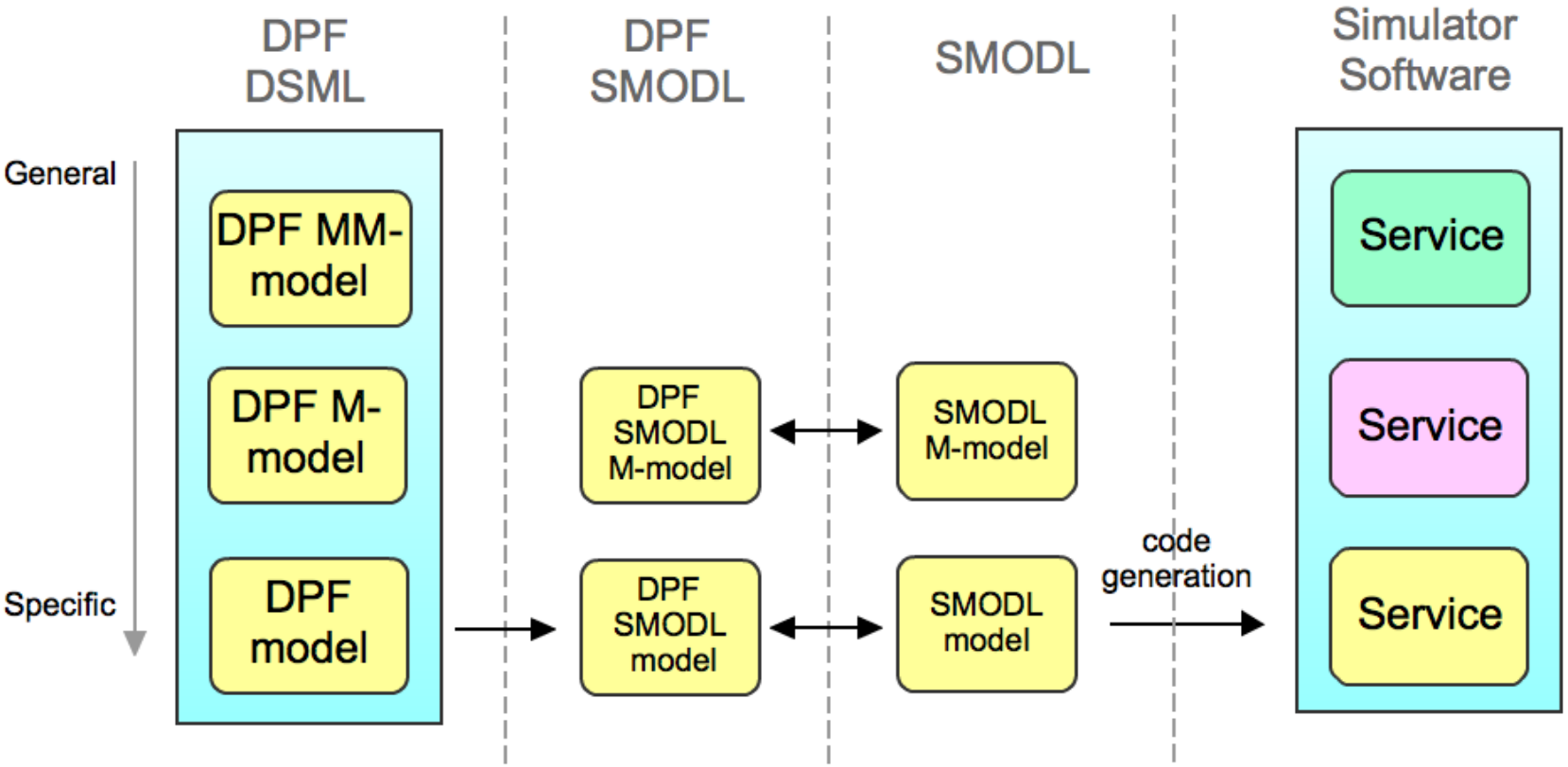
Outline

DSML and Metamodels

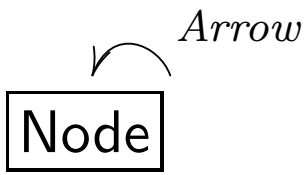
- Domain Specific (modelling) Languages (DSMLs) are (modelling) languages made for a specific domain
- DSMLs are specified by metamodels:
  - The domain specific types
  - Domain specific constraints that the models need to fulfill
- Diagram Predicate Framework (DPF) is a formal diagrammatic approach to MDE, `http://dpf.hib.no`
- DPF is used to construct a modeling hierarchy for part of the offshore domain

DSML for propulsor system

Approach

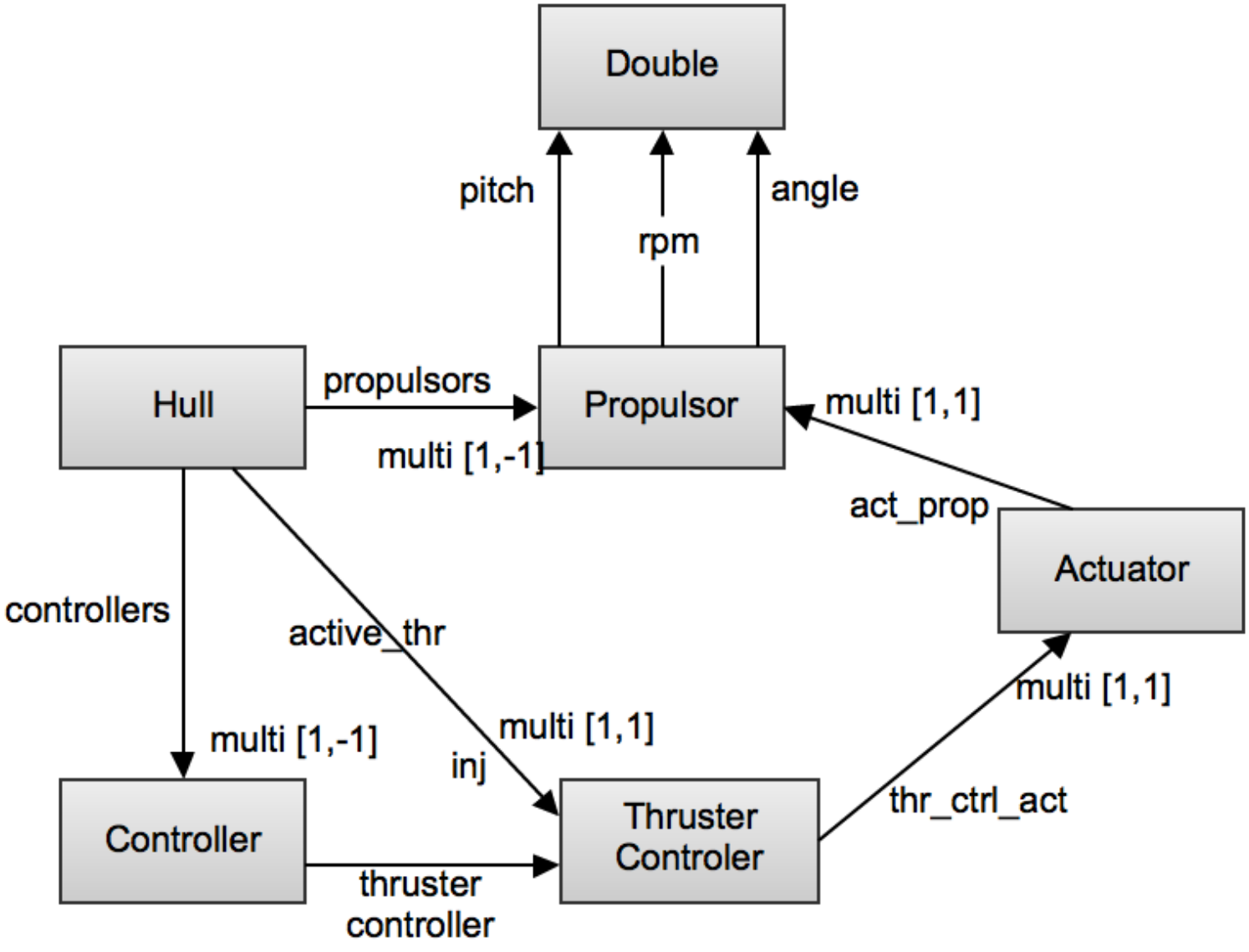

DPF DSML
DPF SMODL
SMODL
Simulator Software
General
Specific
DPF MM-model
DPF M-model
DPF model
DPF SMODL M-model
DPF SMODL model
SMODL M-model
SMODL model
code generation
Service
Service
Service

Deafult metamodel $\mathfrak{S}_3$ in DPF

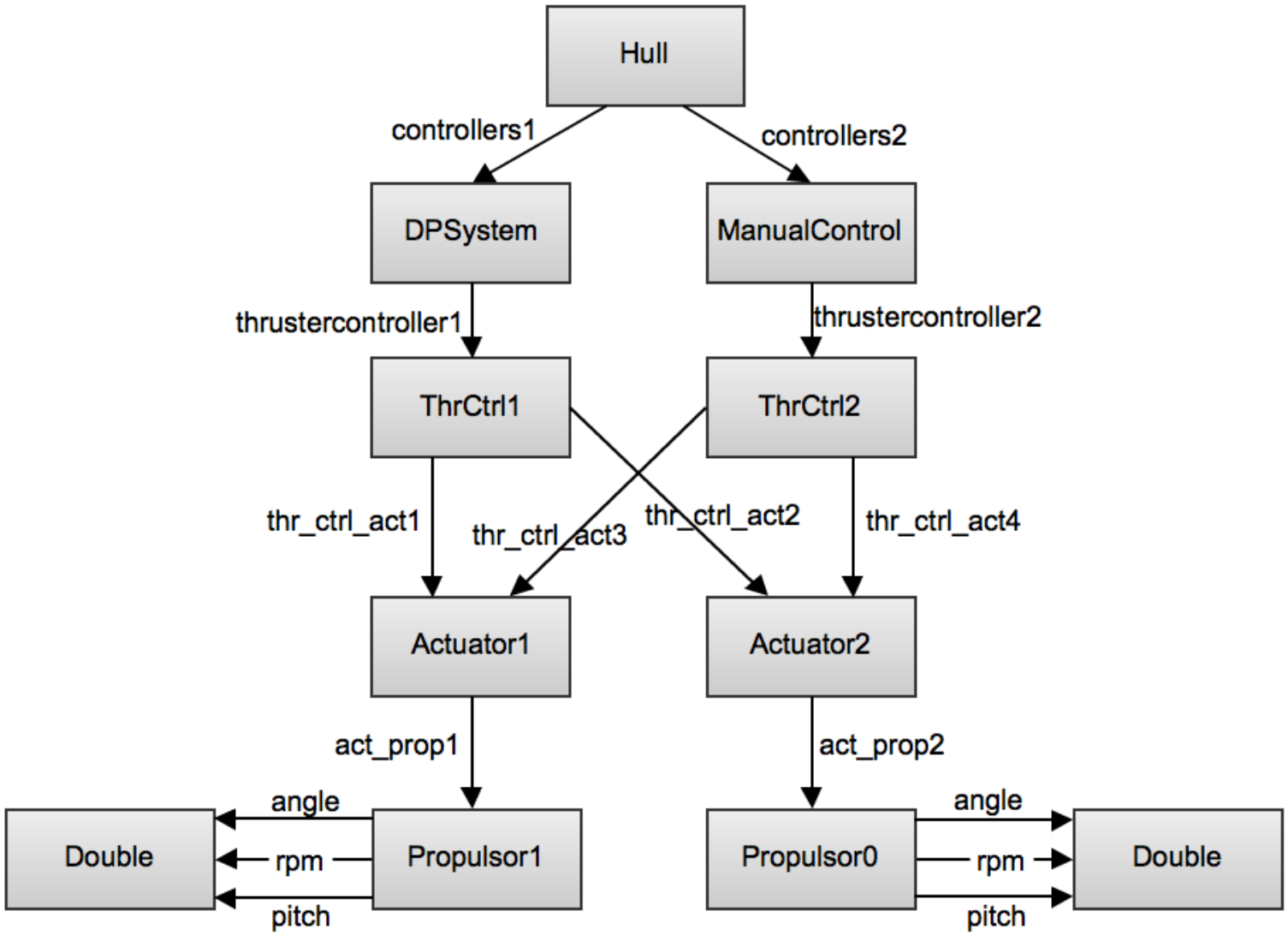


- DPF's default metamodel $\mathfrak{S}_3$ consisting of $Node$ and $Arrow$

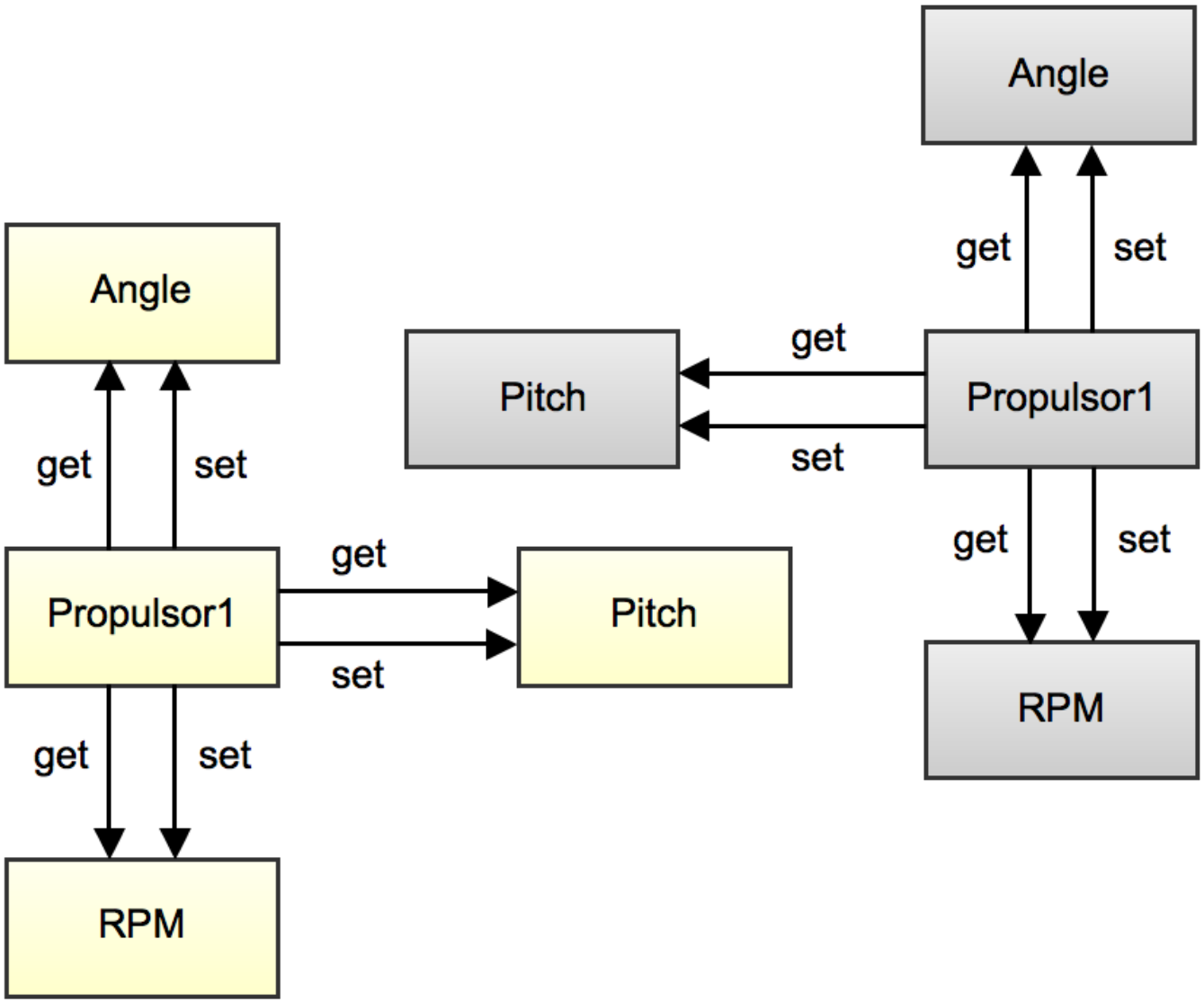
Propulsor metamodel $\mathfrak{S}_2$ typed by $\mathfrak{S}_3$



Propulsor model $\mathfrak{S}_1$ typed by $\mathfrak{S}_2$



Service model transformed from $\mathfrak{S}_1$



Outline

Summary and Future Work

- We have presented a metamodel approach to model driven service development for an offshore simulator
- The flow of this process is:
  1. Construct a DPF modelling hierarchy for the offshore domain
  2. Transform domain models to internal DPF-SMODL models
  3. Transform DPF-SMODL models to SMODL models
  4. Generate services from the SMODL models
  5. Run the services in the simulator
- In the future we will:
  - Construct a complete DSML for the offshore simulation domain
  - Automate services generation from domain specific models
  - A major challenge will be to model and generate software for physical behavior (wind, sea,. . .)
  - Improve the visual syntax of the model editor

Thanks for your attention

Questions?