
Pump example specification

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Contents

- 1. Introduction** **1**
- 2. Decomposition level 1** **3**
 - 2.1. Drive-mechanism 3
 - 2.1.1. Goal function requirements 3
 - 2.1.2. Transformation function requirements 3
 - 2.1.3. Quantitative design constraints 4
 - 2.1.4. Qualitative design requirements 4
 - 2.1.5. External models 4
 - 2.1.6. Sub-components 4
 - 2.2. Pump 4
 - 2.2.1. Transformation function requirements 5
 - 2.2.2. Quantitative design requirements 5
 - 2.2.3. Quantitative design constraints 5
- 3. Decomposition level 2** **7**
 - 3.1. Power-source 7
 - 3.1.1. Goal function requirements 7
 - 3.1.2. Transformation function constraints 7
 - 3.1.3. Behavior requirements 8
 - 3.1.4. External models 8
 - 3.2. Motor 8
 - 3.2.1. Goal function requirements 8
 - 3.2.2. Transformation function requirements 9
 - 3.2.3. External models 9
 - 3.3. Power-switch 9
 - 3.3.1. Goal function requirements 9
- 4. Conclusion** **11**
- A. List of variables** **15**
 - A.1. Definitions 15

1. Introduction

This PDF is automatically generated based on an ESL specification of a pumping system.

2. Decomposition level 1

This is the first decomposition level which indicates which components play a role in the environment in which the system at hand must operate. In Figure 2.1 the associated multi-domain-matrix (MDM) is shown. The MDM shows the dependencies between the components, the function specifications and the combinations thereof that are relevant to this decomposition level.

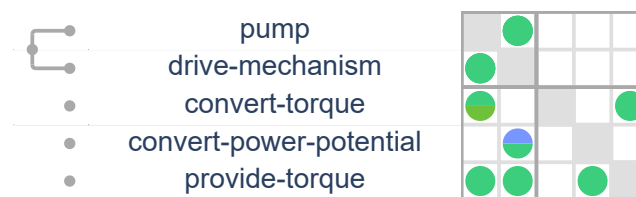


Figure 2.1.: Component – function dependency matrix of decomposition level 1.

2.1. Drive-mechanism

The full decomposition path of this component is *drive-mechanism*.

The following properties are specified for drive-mechanism:

- drive-length

2.1.1. Goal function requirements

provide-torque

Drive-mechanism must provide torque to pump.

2.1.2. Transformation function requirements

drive-mechanism* → *convert-power-potential

Drive-mechanism must convert power-potential into torque.

Subordinate function specifications

drive-mechanism → convert-power-potential

drive-mechanism → power-source → convert-potential

drive-mechanism → motor → convert-power

drive-mechanism → provide-power

2.1.3. Quantitative design constraints

dc-drive-length

Drive-length must be equal to pump-length .

2.1.4. Qualitative design requirements

IP68

Drive-mechanism must be IP68 compliant.

2.1.5. External models

drive-mechanism → power-source → efficiency-model

model definition name

battery-efficiency-model

related variables

drive-mechanism → power-potential

drive-mechanism → power

2.1.6. Sub-components

Drive-mechanism is composed of the following sub-components:

- motor
- power-source
- power-switch

2.2. Pump

The full decomposition path of this component is *pump*.

Can be sourced by manufacturer XYZ. Part number CFG.PMP.0.1

The following properties are specified for pump:

- pump-length

2.2.1. Transformation function requirements

pump → convert-torque

Pump must convert torque into water-flow.

2.2.2. Quantitative design requirements

min-water-flow

Water-flow must be at least 1.0 [L/s].

2.2.3. Quantitative design constraints

dc-drive-length

Drive-length must be equal to pump-length .

3. Decomposition level 2

This decomposition level contains 3 additional components. In Figure 3.1 the associated multi-domain-matrix (MDM) is shown. The MDM shows the dependencies between the components, the function specifications and the combinations thereof that are relevant to this decomposition level.

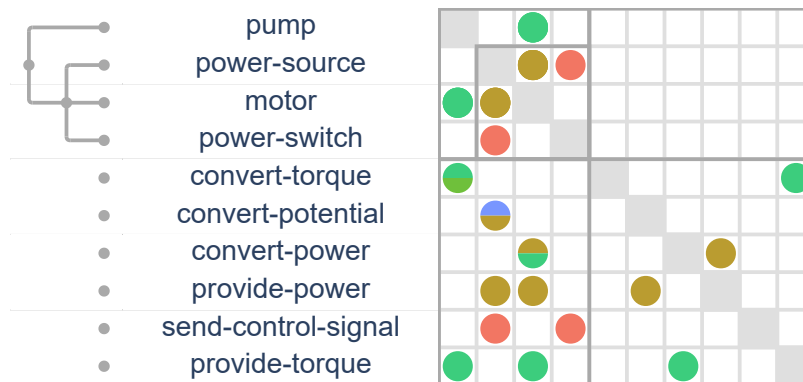


Figure 3.1.: Component – function dependency matrix of decomposition level 2.

3.1. Power-source

The full decomposition path of this component is *drive-mechanism* → *power-source*.

3.1.1. Goal function requirements

drive-mechanism* → *provide-power

Power-source must provide power to motor.

3.1.2. Transformation function constraints

drive-mechanism* → *power-source* → *convert-potential

Power-source does convert power-potential into power.

3.1.3. Behavior requirements

drive-mechanism → *toggle-power*

Case *on*:

when:

- motor-control-signal is equal to True [-]

then:

- power must be at least 300 [W]

Case *default*:

when no other case applies, then:

- power must be equal to 0 [W]
-

3.1.4. External models

drive-mechanism → *power-source* → *efficiency-model*

model definition name

battery-efficiency-model

related variables

drive-mechanism → *power-potential*

drive-mechanism → *power*

3.2. Motor

The full decomposition path of this component is *drive-mechanism* → *motor*.

3.2.1. Goal function requirements

provide-torque

Motor must provide torque to pump.

Clarification

This goal function requirement automatically migrated from *drive-mechanism*.

3.2.2. Transformation function requirements

drive-mechanism → motor → convert-power

Motor must convert power into torque, with subclauses:

- conversion must be at least 0.8
-

3.2.3. External models

drive-mechanism → power-source → efficiency-model

model definition name

battery-efficiency-model

related variables

drive-mechanism → power-potential

drive-mechanism → power

3.3. Power-switch

The full decomposition path of this component is *drive-mechanism → power-switch*.

3.3.1. Goal function requirements

drive-mechanism → send-control-signal

Power-switch must send motor-control-signal to power-source.

4. Conclusion

For more information on system specification and architecture modelling. Please contact Ratio Computer Aided Systems Engineering B.V.

Appendices

A. List of variables

A.1. Definitions

Variable	Type	Domain	Units	Clarification
<i>drive-length</i>	Spatial-measure	$0.0 [m] \leq x$		
<i>drive-mechanism</i> → <i>motor</i> → <i>conversion</i>	Efficiency	$0.0 \leq x \leq 1.0$		
<i>drive-mechanism</i> → <i>motor-control-signal</i>	Control-signal			
<i>drive-mechanism</i> → <i>power</i>	Electrical-energy-flow		W	
<i>drive-mechanism</i> → <i>power-potential</i>	Energy-potential		Wh	
<i>pump-length</i>	Spatial-measure	$0.0 [m] \leq x$		
<i>torque</i>	Mechanical-energy-flow		Nm	Comments on variable torque. Comments on variable torque. Comments on variable torque.
<i>water-flow</i>	Liquid-material-flow		L/s	

