

Computer aided configuration of mechatronic systems – a new approach to support conceptual design activities in product development

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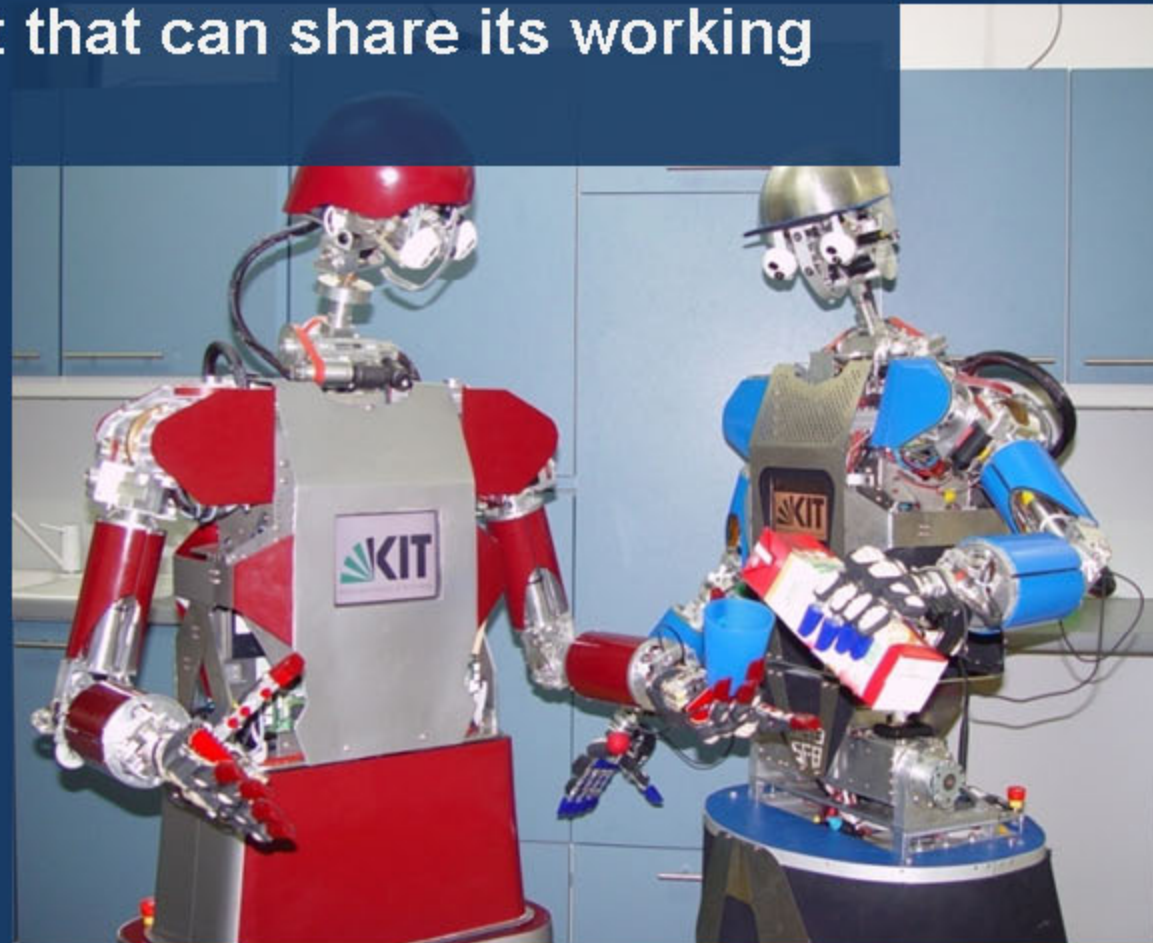
- Motivation
- Approach
- Summary and Outlook

- motivation
- approach
- summary and outlook

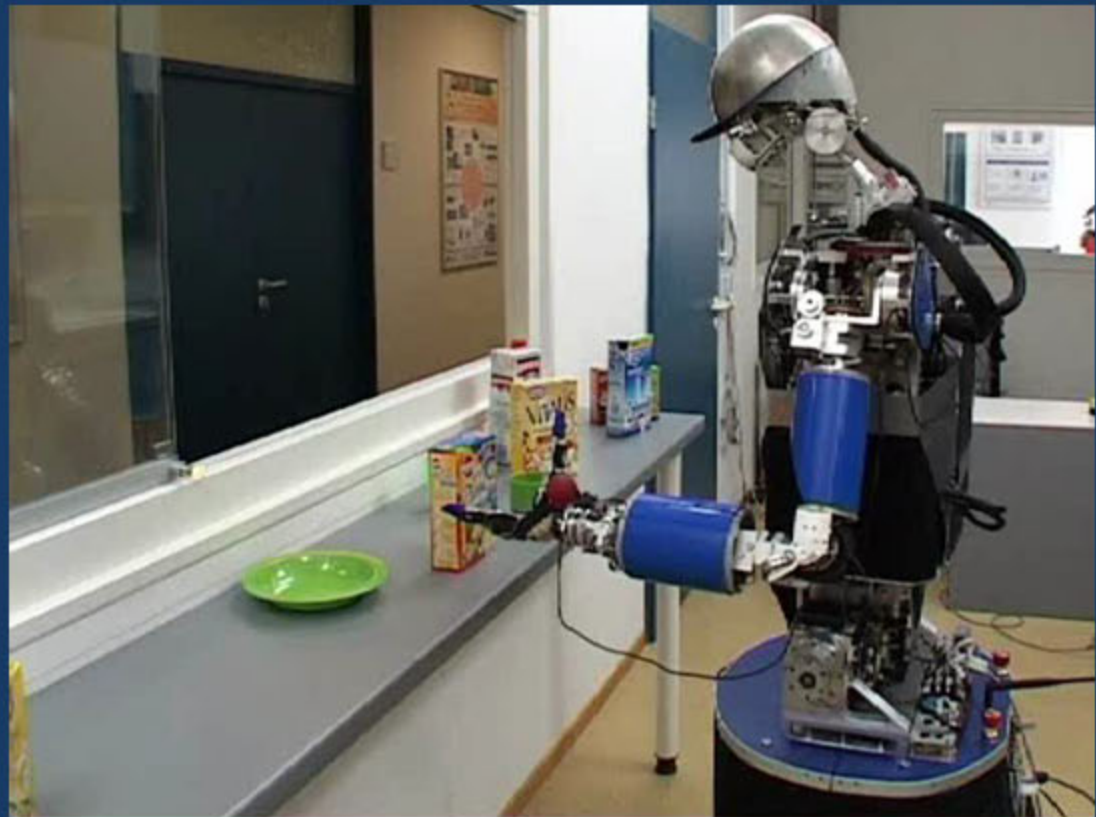
- Objective of SFB588: Development of concepts, methods and concrete mechatronic components for a humanoid robot that can share its working space with humans

Deutsche
Forschungsgemeinschaft

DFG



- Objective of SFB588: Development of concepts, methods and concrete mechatronic components for a humanoid robot that can share its working space with humans

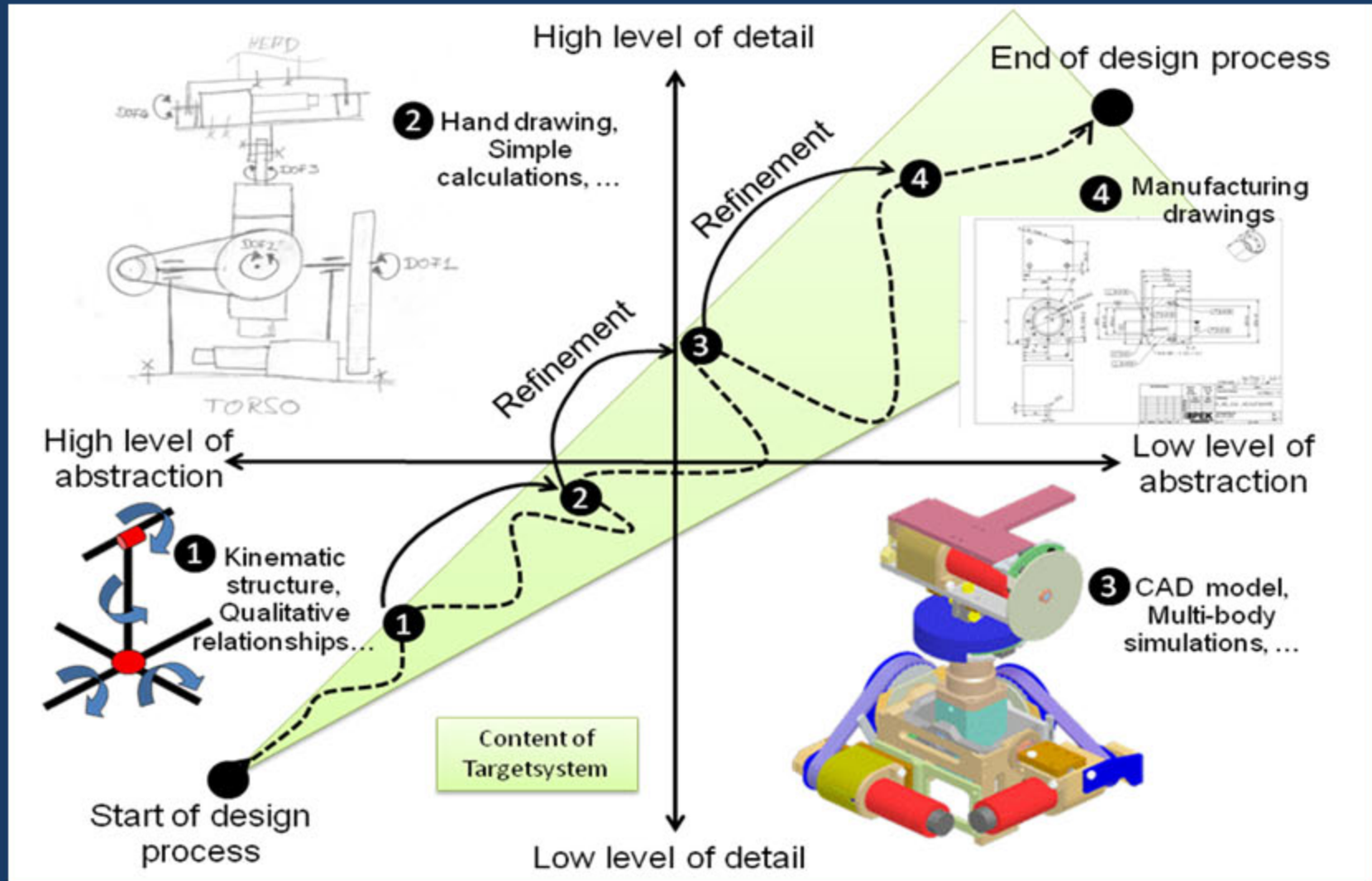


- development of ARMAR IV-V
- no evolution but revolution (e.g. elbow)
- application of approved components
- multidomain development
→ high complexity

- How do we determine an “optimal” configuration?

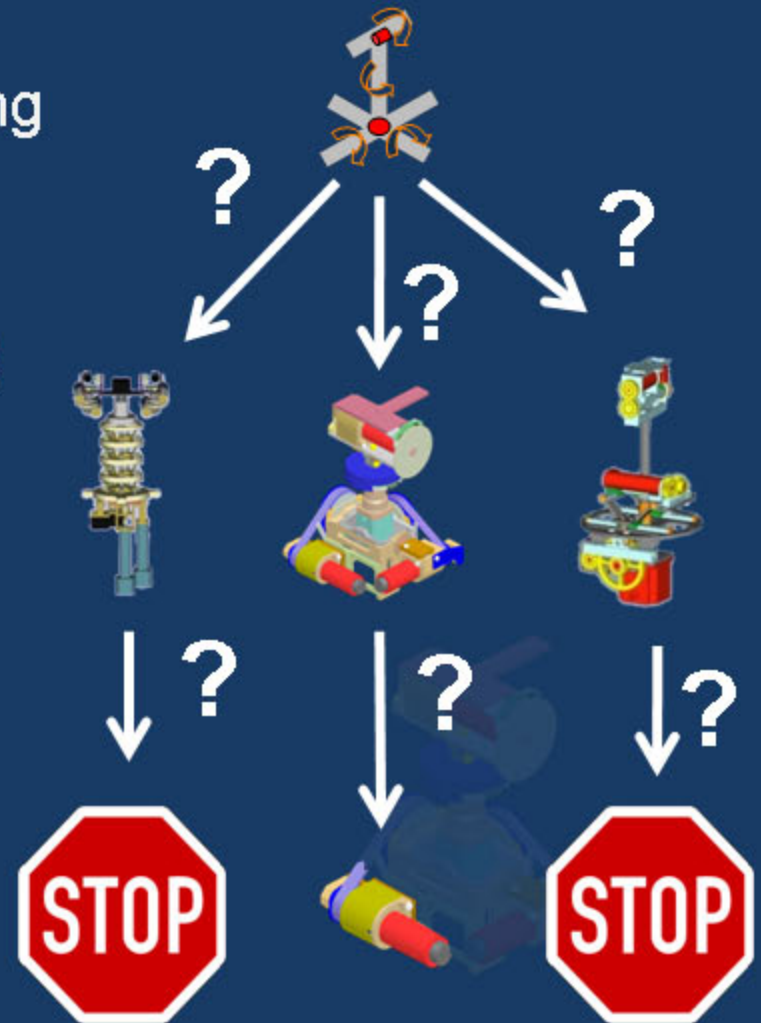
- additional challenge:
→ fast determination of new optimal configurations after changed boundary conditions





Development process often includes divergencies and iterations (fluctuating BCs)

- (semi-) automatic configuration and weighting of (sub-) systems
- computer-aided optimization of generated configurations

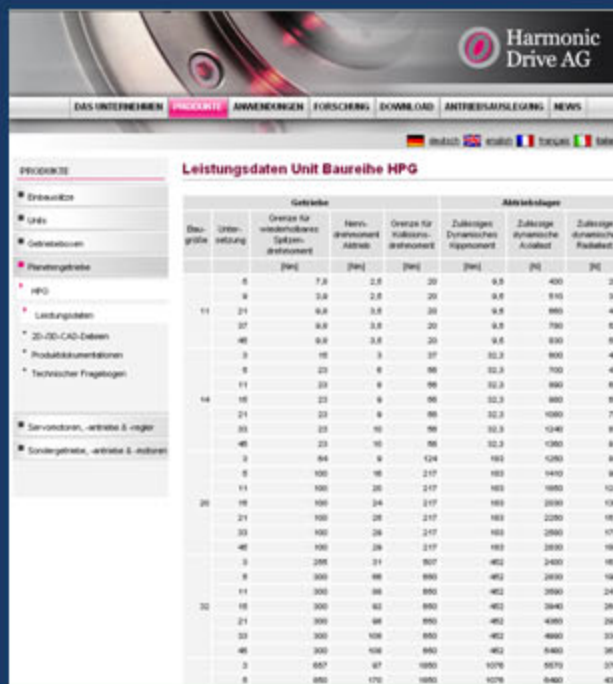


■ challenge:

- big number of catalogues with diverse structures
- selection of suitable and foremost compatible components difficult
- diversity of solution hard to oversee
- Which one is the “optimal” configuration?

■ idea:

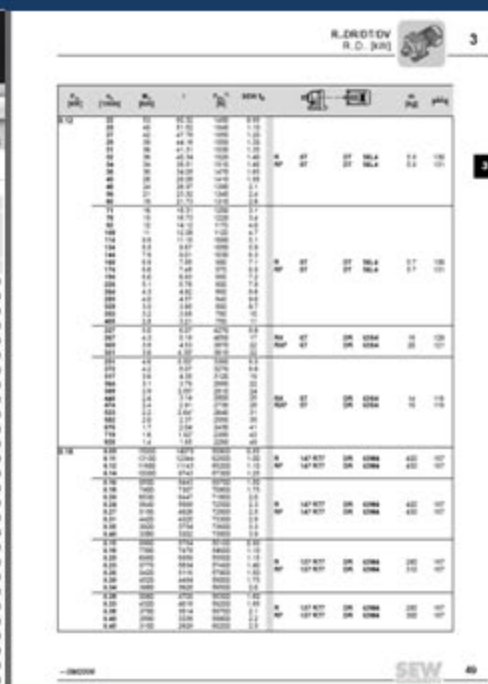
computer-aided generation of suitable and compatible component configurations



Harmonic Drive AG

Leistungsdaten Unit Baureihe HPG

Bau- größe	Unter- teilung	Getriebe			Motorleistungen		
		Grenzen für wiederholbare System- antriebsmomente	Nenn- antriebsmoment	Grenzen für substantive Antriebsmomente	Zulässige Dynamische Nippanmomente	Zulässige dynamische Antriebs- momente	Zulässige dynamische Fliehkraft
		[Nm]	[Nm]	[Nm]	[Nm]	[Nm]	[Nm]
5		7,5	2,5	20	9,5	400	200
9		9,5	3,5	20	9,5	510	240
11	21	9,5	3,5	20	9,5	660	240
	27	9,5	3,5	20	9,5	700	320
	40	9,5	3,5	20	9,5	800	360
	5	15	5	37	32,5	800	400
	9	23	9	56	32,5	700	470
	11	23	9	56	32,5	800	500
	14	15	5	36	32,5	800	500
	21	23	9	56	32,5	1000	700
	35	23	10	56	32,5	1240	800
	40	23	10	56	32,5	1200	810
	5	8,5	3	24	100	1200	840
	9	100	10	217	100	1410	800
	11	100	20	217	100	1600	1240
	20	100	24	217	100	2000	1300
	21	100	20	217	100	2200	1610
	33	100	24	217	100	2500	1720
	40	100	24	217	100	2600	1600
	5	200	21	507	402	2400	1600
	9	300	30	600	402	2600	1600
	11	300	30	600	402	2600	2410
	20	300	30	600	402	3040	2040
	21	300	30	600	402	3000	2000
	33	300	30	600	402	3000	2140
	40	300	30	600	402	3400	2070
	5	657	47	1000	1076	5070	2700
	9	800	170	1000	1076	6400	4000



SEW

Table with columns for motor type, power, speed, torque, and efficiency.

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maxon motor

e-Shop

driven by precision

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[DE / EN]

Your shopping cart (0)

Total: EUR 0.00
excl. VAT



Product Finder

Please select a product using the search possibilities below

Types:
 Power rating (W):
 Ø (mm):
 max. length (mm):
 Nominal torque up to [Nm]:

Results per page
 Results : 1 to 10 of 1230 hits

Products

- ▼ maxon DC motor
 - A Program
 - A-max Program
 - RE Program
 - RE-max Program
- ▶ maxon EC motor
- ▶ maxon gear
- ▶ maxon tachometer
- ▶ maxon motor control
- ▶ maxon accessories

Quick search

Direct order

▶ Direct order

Login

- ▶ Forgotten your password?
- ▶ New registration

Results

Order No.	Program	Max. Ø (mm) ↑↓	P [W] ↑↓	Un [V] ↑↓	n ₀ [min ⁻¹] ↑↓	M _n [Nm] ↑↓	Downloads	Combine with	Price EUR 1 pc(s)	Quantity
2516...	A 2516 Ø16 mm, Precious Metal Brushes, 0.8 Watt	16	0.8	12	16100	0.654			25.80	<input type="text" value="1"/>
2516...	A 2516 Ø16 mm, Precious Metal Brushes, 0.8 Watt	16	0.8	24	18200	0.661			30.20	<input type="text" value="1"/>
2516...	A 2516 Ø16 mm, Precious Metal Brushes, 0.8 Watt	16	0.8	4.5	16600	0.759			25.80	<input type="text" value="1"/>
2520...	A 2520 Ø20 mm, Precious Metal Brushes, 1.2 Watt	20	1.2	9	13400	0.998			28.47	<input type="text" value="1"/>
2520...	A 2520 Ø20 mm, Precious Metal Brushes, 1.2 Watt	20	1.2	12	13000	0.858			33.33	<input type="text" value="1"/>
2520...	A 2520 Ø20 mm, Precious Metal Brushes, 1.2 Watt	20	1.2	6	13600	1.07			33.33	<input type="text" value="1"/>
200938	A-max 12 Ø12 mm, Precious Metal Brushes CLL, 0.5 Watt, CE approved	12	0.5	3	13700	0.866			31.27	<input type="text" value="1"/>
265389	A-max 12 Ø12 mm, Precious Metal Brushes CLL, 0.5 Watt, CE approved	12	0.5	4.5	11700	0.935			31.27	<input type="text" value="1"/>
265390	A-max 12 Ø12 mm, Precious Metal Brushes CLL, 0.5 Watt, CE approved	12	0.5	6	12600	0.921			31.27	<input type="text" value="1"/>

No combination in progress - Add with this function an article in the combination.

Stock program
 Standard program
 Special program

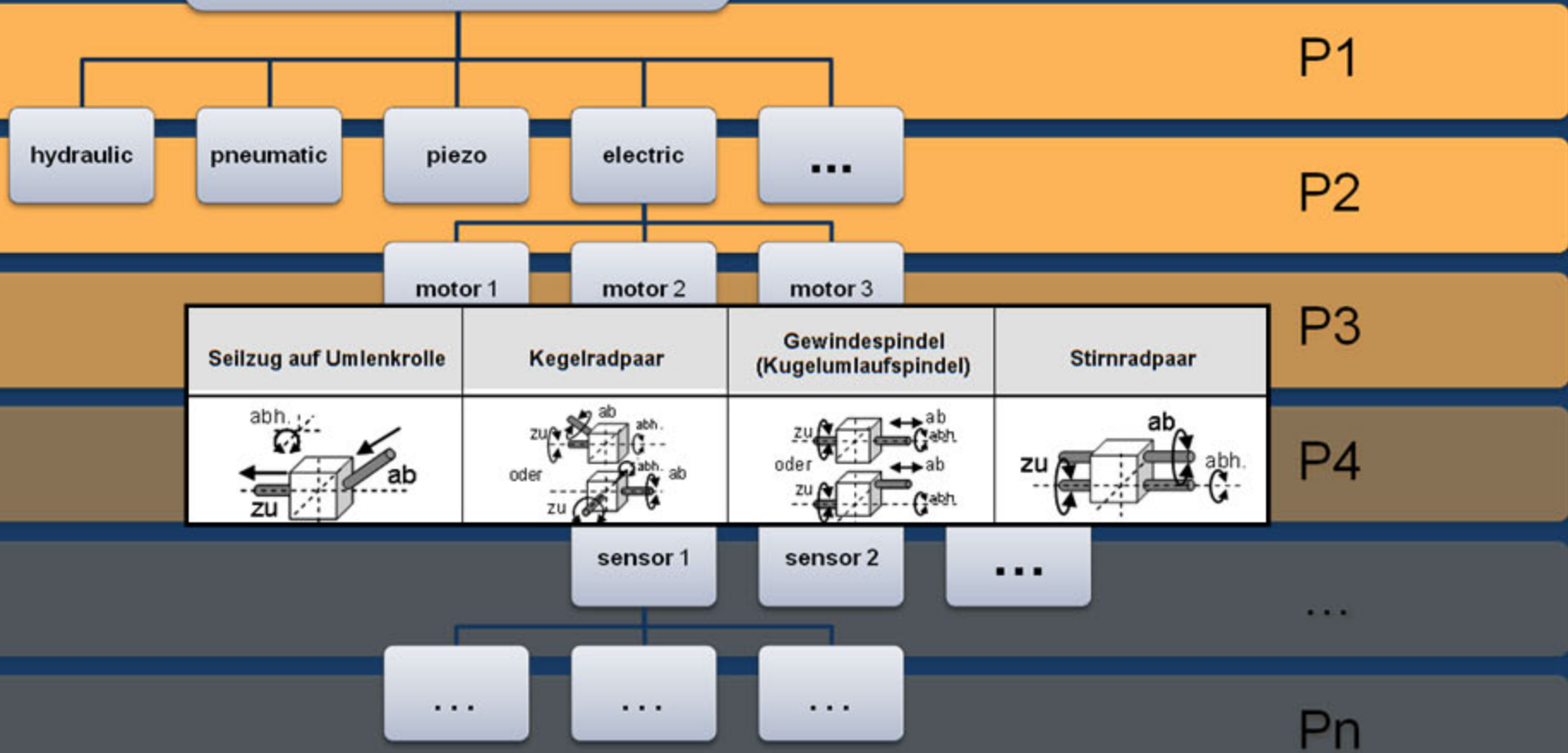
- Are there any existing configurations for subsystems, with which the requirements can be fulfilled?
- Are there configurations of subsystems, that are compatible to each other?
- **precondition:**
All component parameters must be stored in a proper classification.

Two-stage method:

- **phase 1 – configuration phase**
computer-aided **selection of suitable configurations (not only components!)** using standardized component libraries
- **phase 2 – optimization phase**
computer-aided **determination of free parameters** (search of optimal configuration, placement of configurations within design space, ...)

Phase 1: Configuration

system of objectives
 (e.g.: drive unit for nodding the head)



- precondition :
All component parameters must be stored in a proper classification: Excel-Sheet → XML

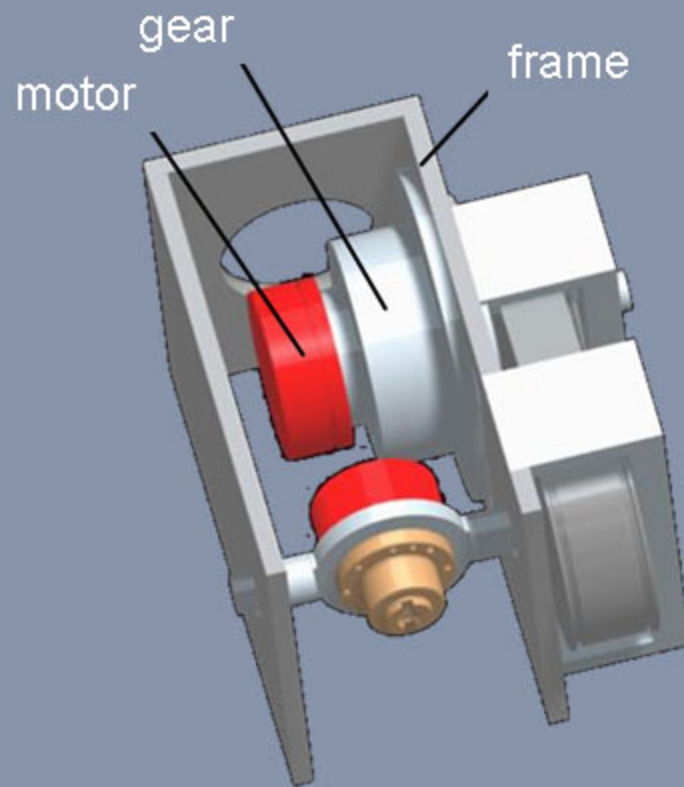
manufacturer	product id	torque	efficiency factor	dimension x	dimension y	dimension z	diameter	voltage
SEW	S/00102	10	0.91	45	90	177	4	24
SEW	S/00103	15	0.91	35	85	185	6	12
SEW	S/00104	20	0.89	34	93	105	6	12
SEW	S/00105	25	0.90	33	81	100	11	12
SEW	S/00106	30	0.85	31	99	193	12	24
SEW	S/00107	35	0.92	31	100	184	5	12
SEW	S/00108	40	0.93	35	84	106	6	12
Maxon	m-33541	35	0.82	31	85	178	10	24
Maxon	m-33542	20	0.86	45	88	137	8	12
Maxon	m-33543	15	0.85	32	100	150	2	12
Maxon	m-33544	10	0.87	38	94	181	10	24
Faulhaber	F14235	20	0.83	30	86	194	4	12
Faulhaber	F14236	23	0.79	32	94	137	9	12
Faulhaber	F14237	27	0.81	42	99	192	5	12
Faulhaber	F14238	32	0.81	31	95	175	7	12
Parker	512p	15	0.81	40	100	187	7	12
Parker	513p	12	0.76	43	87	196	5	12

■ Precondition :

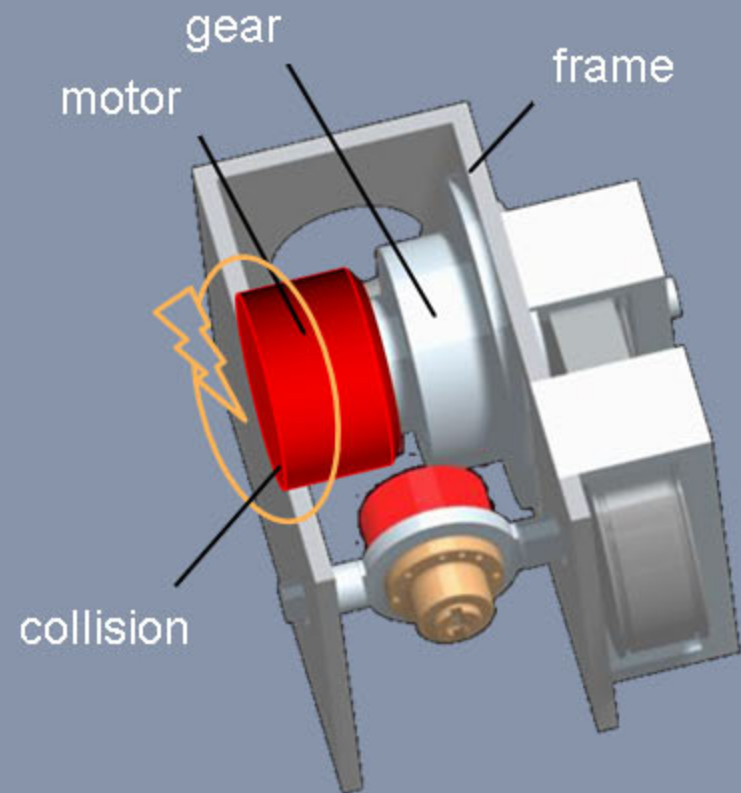
All component parameters must be stored in a proper classification: Excel-Sheet → XML

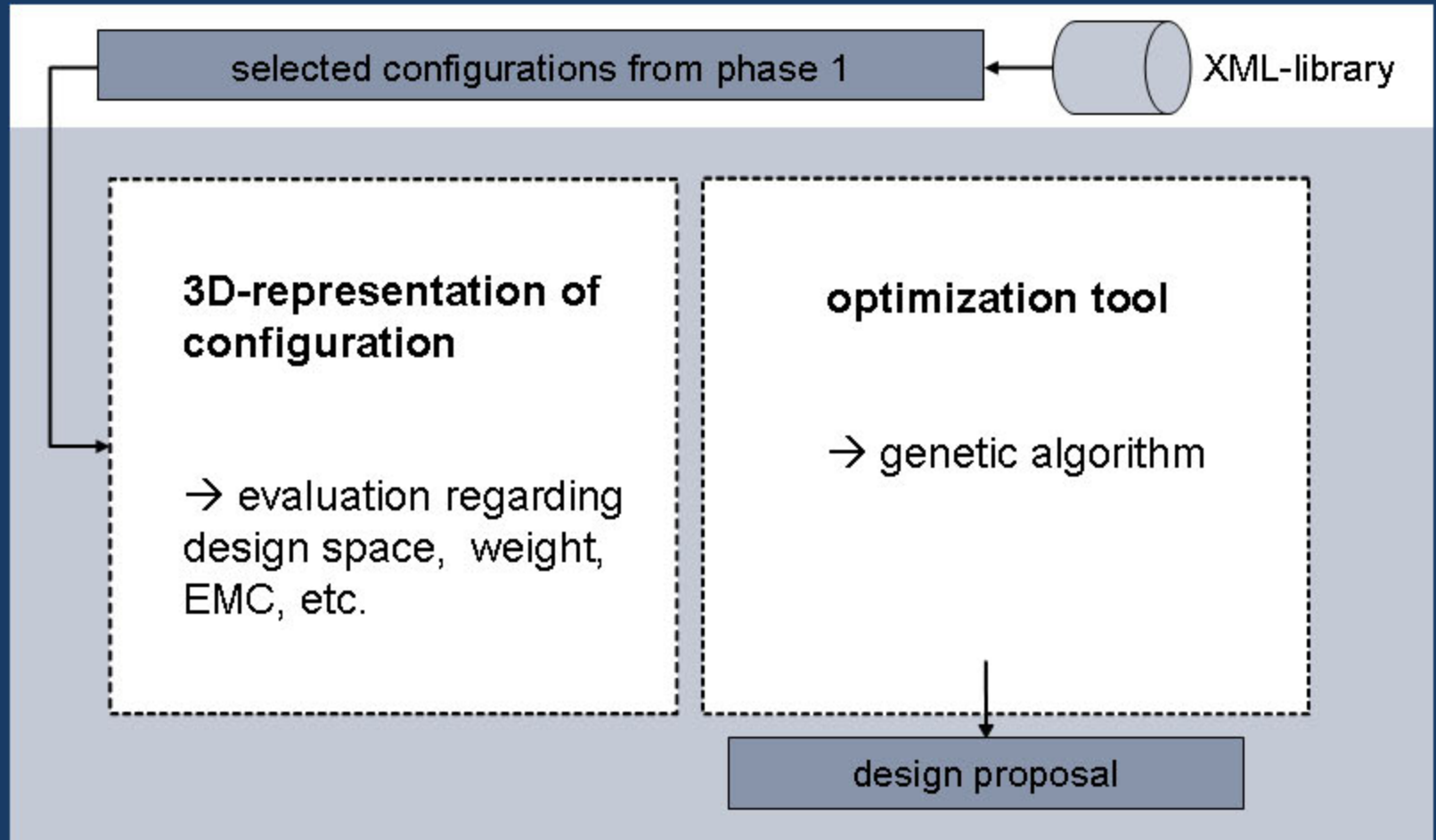
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    <value> 10 </value>
  </parameter >
  < parameter >
    <label> voltage [V]</label>
    <value> 24 </value>
  </ parameter >
  ...
</root>
```


configuration 1

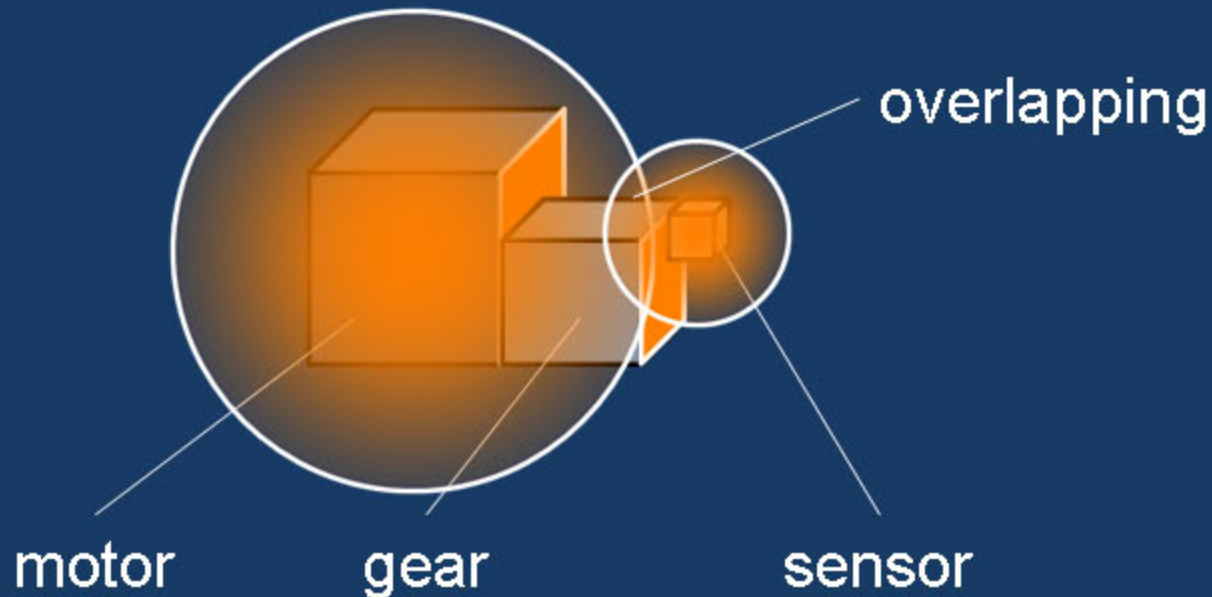


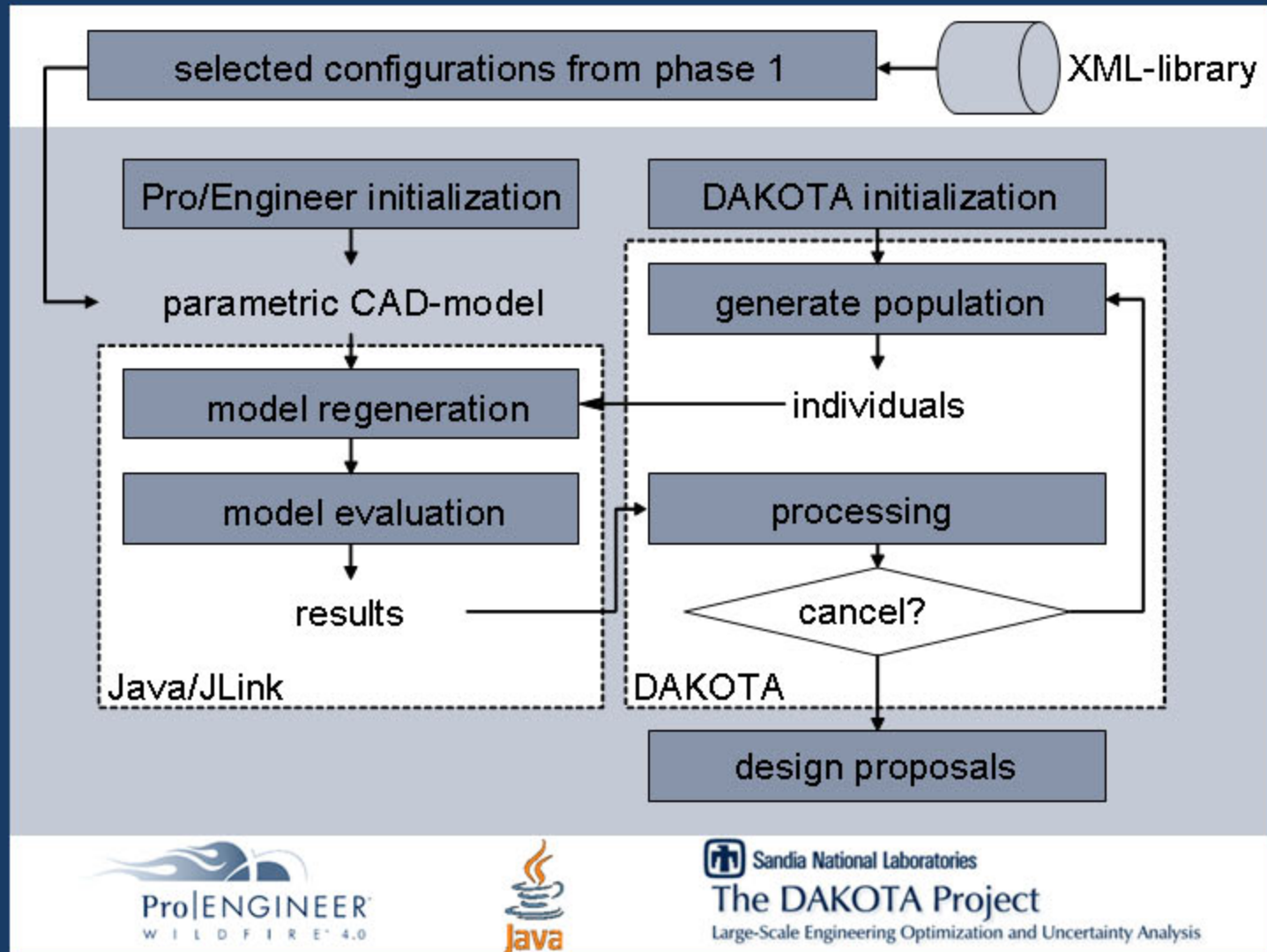
configuration 2





- **example: electromagnetic compatibility**
 - based on CAD-models including information regarding mechanical interfaces
 - automatic checking of diverse constraints
 - evaluation of configurations resp. concept





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■ Summary:

- Support configuration process using computer-aided methods
- Reduce risk to forget possible solutions
- Make sure to find optimal configurations
- Implementation still under progress

■ Outlook:

- Integration of other software tools like Matlab/Simulink:
 - simulation and evaluation of dynamic behavior
 - exchange of CAD-Data between ProE Simulink via XML
- Implementation as a completely automated process
- Refeeding of already know solutions / integration in PDM-System

Thank you for your attention