

KOENIG & BAUER

A law of propulsion/motion for an
elastic mechanism -
how can I come up with

we're on it.



Inhalt

- 1 Koenig & Bauer
- 2 sheetfed press – operation principles
- 3 gripper and gripperbar
- 4 Optislang project to optimize a law of motion
- 5 High Performance Cluster - HPC

We stand for printing in its broadest diversity

Koenig & Bauer AG

Sheetfed

Koenig & Bauer Sheetfed AG & Co. KG

Sheetfed offset, digital sheetfed printing, finishing and post-press

Koenig & Bauer Grafitec s.r.o.

Sheetfed offset

Koenig & Bauer Iberica Die Cutters S.A.

Post-press

**Koenig Bauer Duran Karton Ambalaj
Teknolojileri Sanayi A.Ş.**

Digital & Webfed

**Koenig & Bauer Digital & Webfed
AG & Co. KG**

Web offset, digital web printing

Koenig & Bauer Flexotecnica S.p.A.

Flexible packaging printing

Koenig & Bauer FT Engineering GmbH

Engineering services, web presses and external

PrintHouseService GmbH

Service, web offset

Special

**Koenig & Bauer
Kammann GmbH**

Printing on glass and hollow containers

**Koenig & Bauer
MetalPrint GmbH**

Metal decorating

**Koenig & Bauer
Coding GmbH**

ID systems and labelling

**KBA-NotaSys AG &
Co. KG**

Security printing (design)

**Koenig & Bauer (AT)
GmbH**

Security printing (assembly)

KBA-NotaSys SA

Security printing (sales/service)

Industrial

Koenig & Bauer Industrial AG & Co. KG**Albert-Frankenthal GmbH****Koenig & Bauer Gießerei GmbH**

Koenig & Bauer in the year 2019

5,500

employees worldwide

11

production sites

109

sales and service
sites

€1.2 bn

group sales 2018



We manufacture at locations across Europe

1 Würzburg, DE

Web offset, digital web and security presses, industrial solutions
Employees: approx. 1,500

2 Radebeul, DE

Sheetfed offset and digital sheetfed presses, rotary die-cutter, industrial solutions
Employees: approx. 1,800

3 Stuttgart, DE

Metal decorating presses
Employees: approx. 320

4 Mödling, AT

Banknote and security presses
Employees: approx. 290

5 Veitshöchheim, DE

ID and labelling systems
Employees: approx. 270

6 Dobruška, CZ

Sheetfed offset presses (half format), industrial solutions
Employees: approx. 250

7 Frankenthal, DE

Folders for newspaper and commercial web presses, rollers, industrial solutions
Employees: 180

8 Bad Oeynhausen, DE

Screen printing machines for the direct decoration of glass and hollow containers
Employees: approx. 140

9 Tavazzano, IT

Flexo web presses
Employees: approx. 100

10 Barcelona, ES

Flat-bed die-cutters
Employees: approx. 60

11 Istanbul, TUR

Folding box gluing machines
Employees: approx. 50



Exciting the world since 1817

90 %

world market share in
banknote and security
printing

80 %

world market share in
metal decorating

63 %

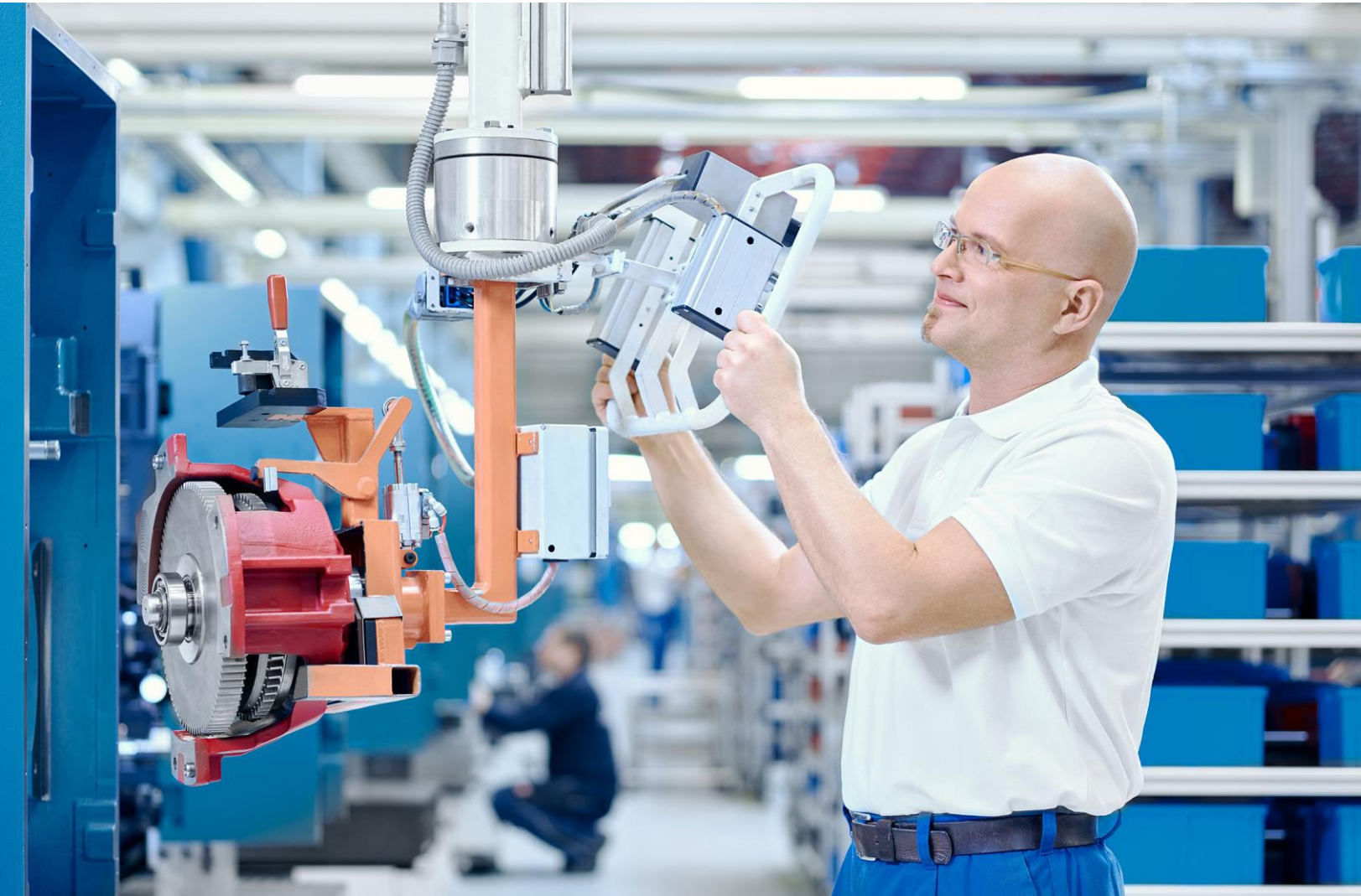
world market share in
large-format and
packaging printing

30 %

world market share in
commercial web and
newspaper printing



Working in Radebeul for the whole world



40,000 m²

state-of-the-art assembly
facilities

1,600

employees worldwide

€647 m

turnover in 2018

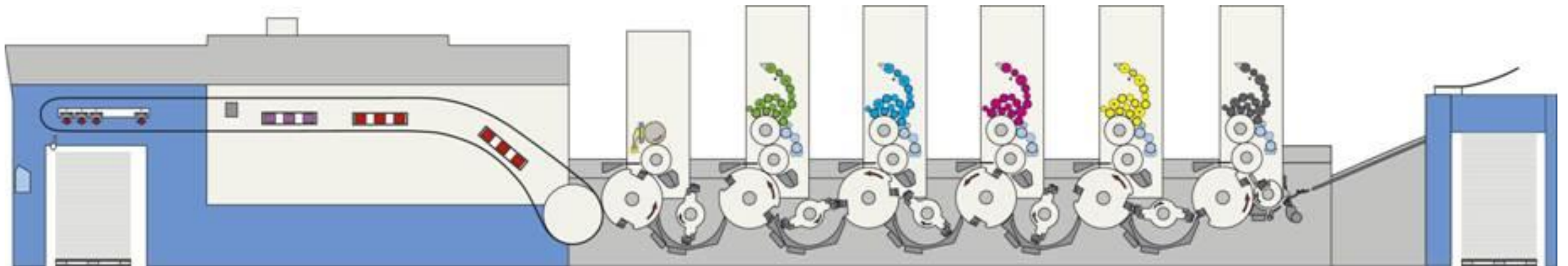
Our machinery solutions

	Half format	Medium format	Large format	Superlarge format
Sheetfed offset				
	Rapida 75 PRO	Rapida 105	Rapida 145	Rapida 185
	Rapida 76	Rapida 105 PRO	Rapida 164	Rapida 205
		Rapida 106		
Digital sheetfed printing		VariJET 106		
Post-press				
Rotary die-cutter		Rapida RDC 106		
Flat-bed die-cutters		I-Press 106	I-Press 144	
		I-Press 106 K	I-Press 144 K	
		Optima 106		
		Optima-K 106		

Rapida line

Paperpath

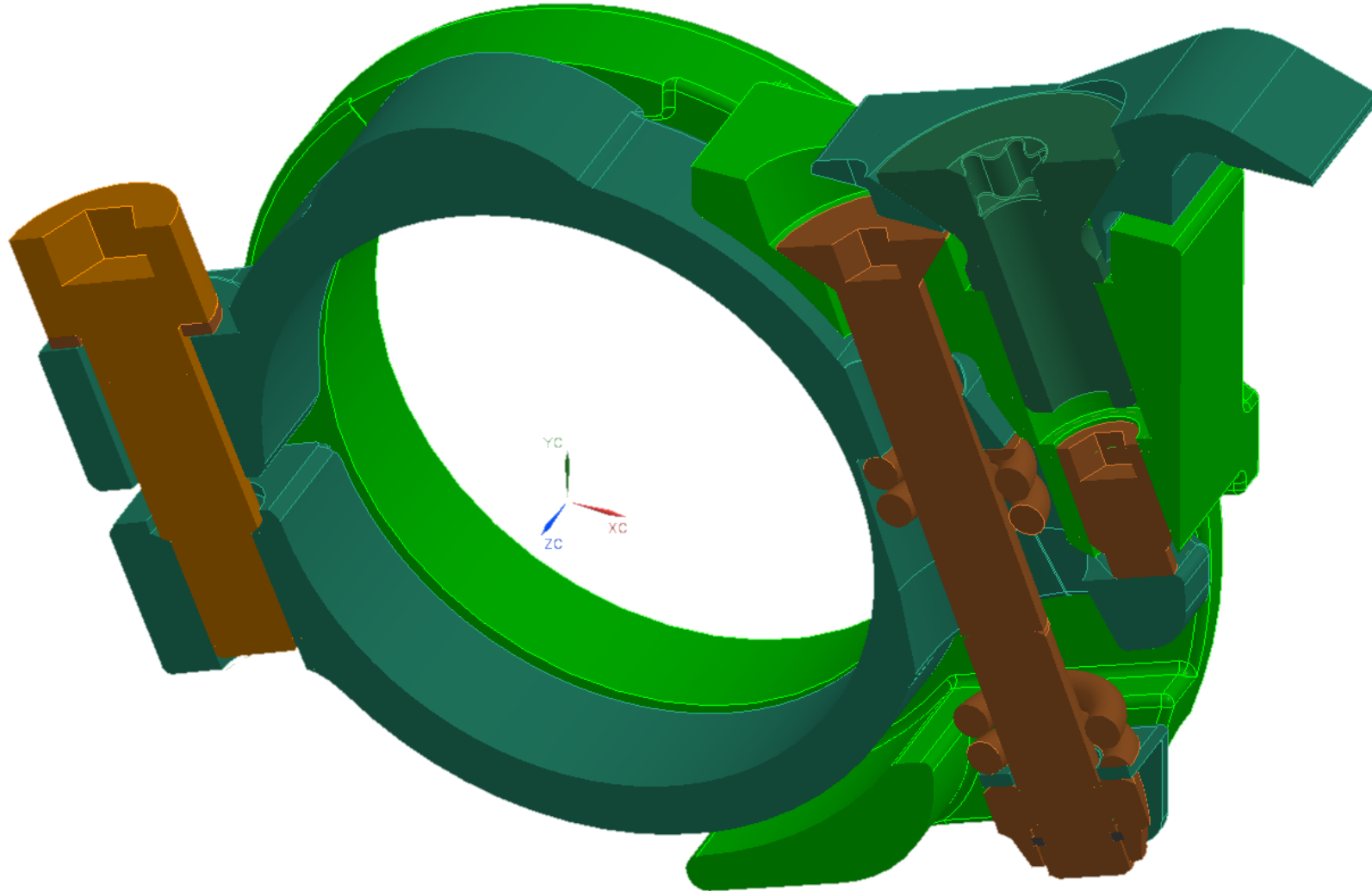
- sheet feeder: separates sheets from the pile
- sheet infeed: aligns the sheets fed from the sheet feeder, accelerates them to the press speed
- grippers: component for holding the paper edge during transport in a printing press at the cylinder, transfer from cylinder to the next cylinder
- delivery: gripperbars transport the printed sheets and stacking them to a new pile



Gripperbar with follower and cam

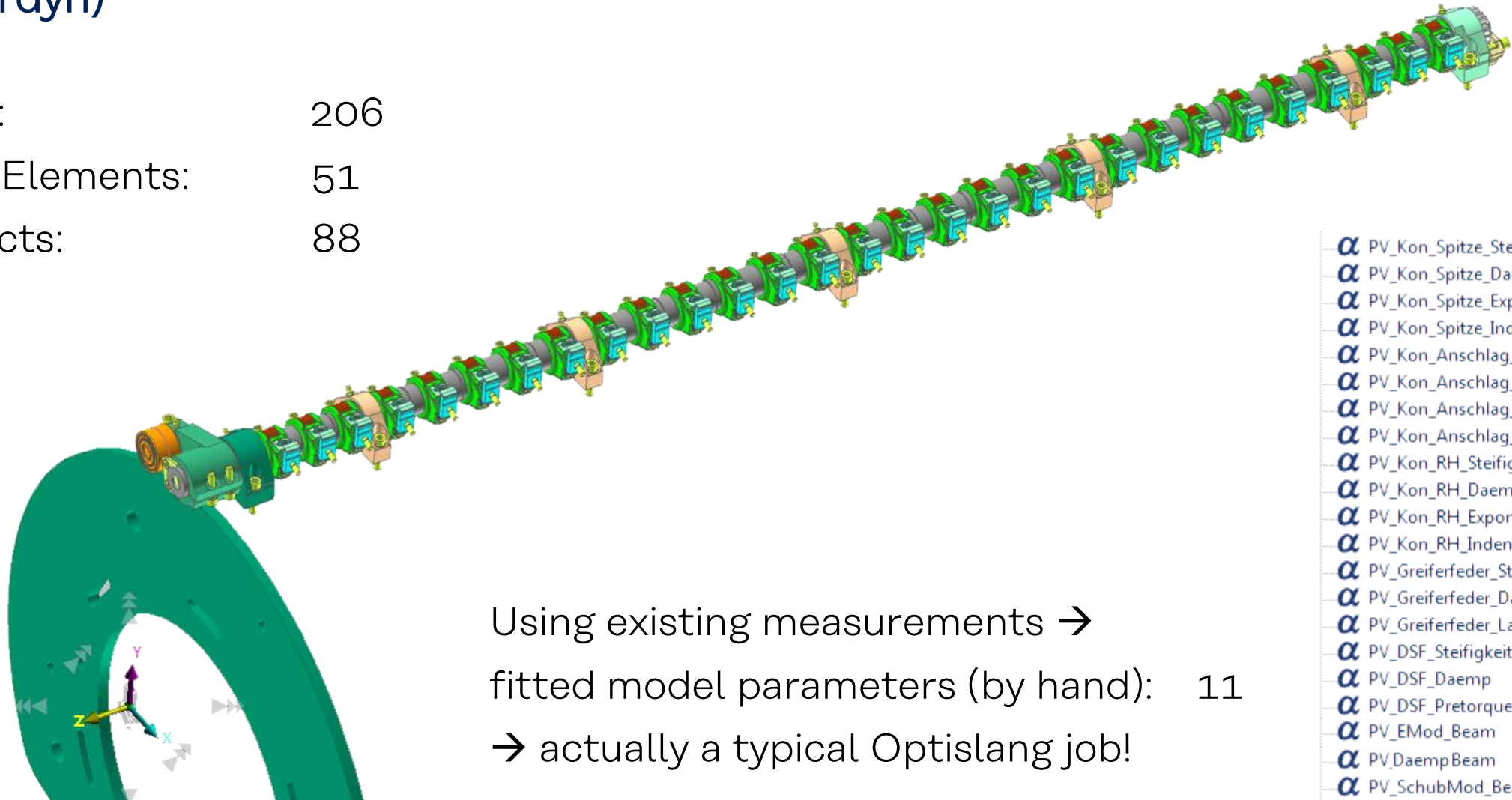


Gripper



Multi-body simulation model „Gripperbar“ (Recurdyn)

Bodys: 206
Force Elements: 51
Contacts: 88

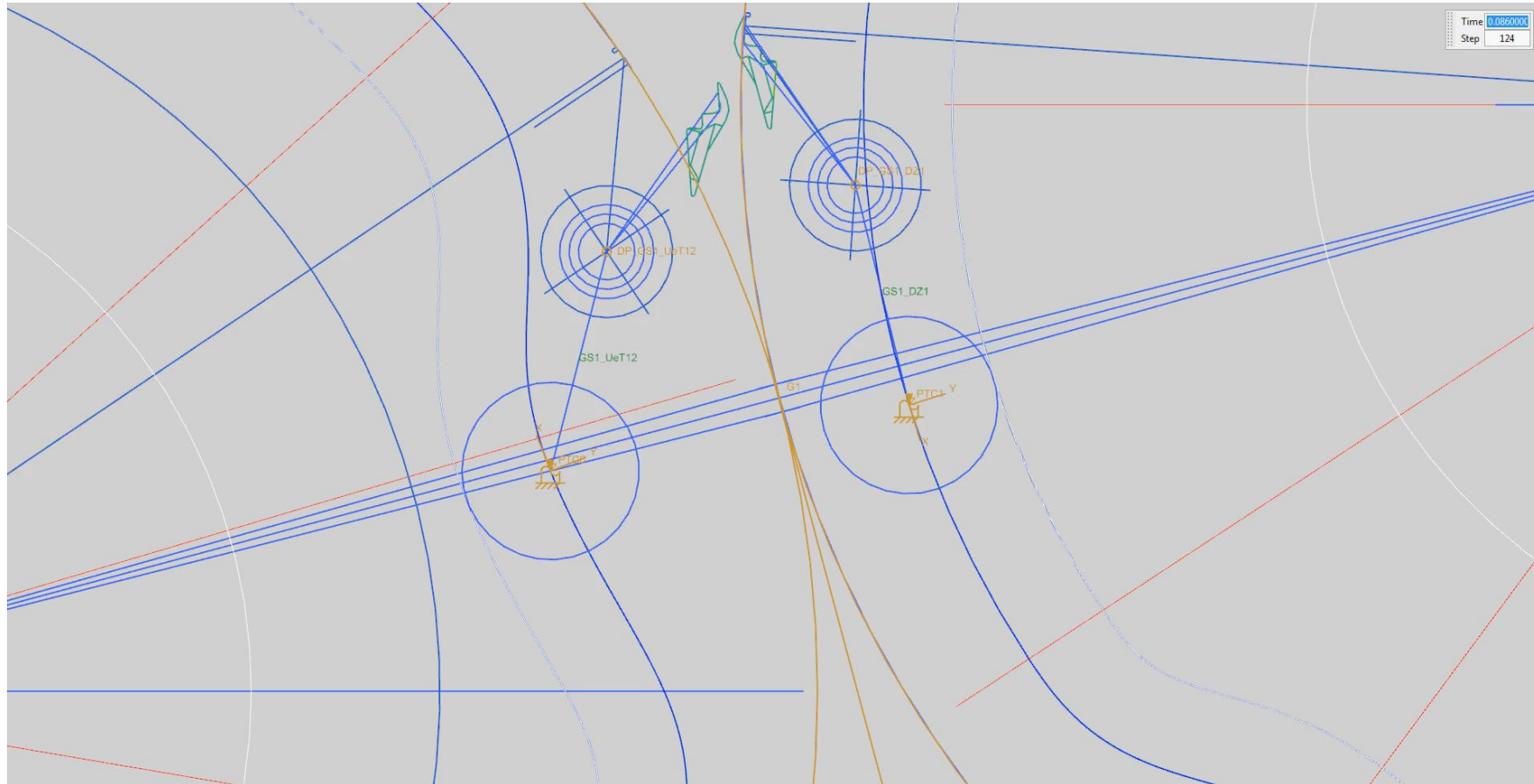


Using existing measurements →
fitted model parameters (by hand): 11
→ actually a typical Optislang job!

- α PV_Kon_Spitze_Steifigkeit
- α PV_Kon_Spitze_Daemp
- α PV_Kon_Spitze_Exponent
- α PV_Kon_Spitze_Indentation
- α PV_Kon_Anschlag_Steifigkeit
- α PV_Kon_Anschlag_Daemp
- α PV_Kon_Anschlag_Exponent
- α PV_Kon_Anschlag_Indentation
- α PV_Kon_RH_Steifigkeit
- α PV_Kon_RH_Daemp
- α PV_Kon_RH_Exponent
- α PV_Kon_RH_Indentation
- α PV_Greiferfeder_Steifigkeit
- α PV_Greiferfeder_Daemp
- α PV_Greiferfeder_Laenge
- α PV_DSF_Steifigkeit
- α PV_DSF_Daemp
- α PV_DSF_Pretorque
- α PV_EMod_Beam
- α PV_DaempBeam
- α PV_SchubMod_Beam

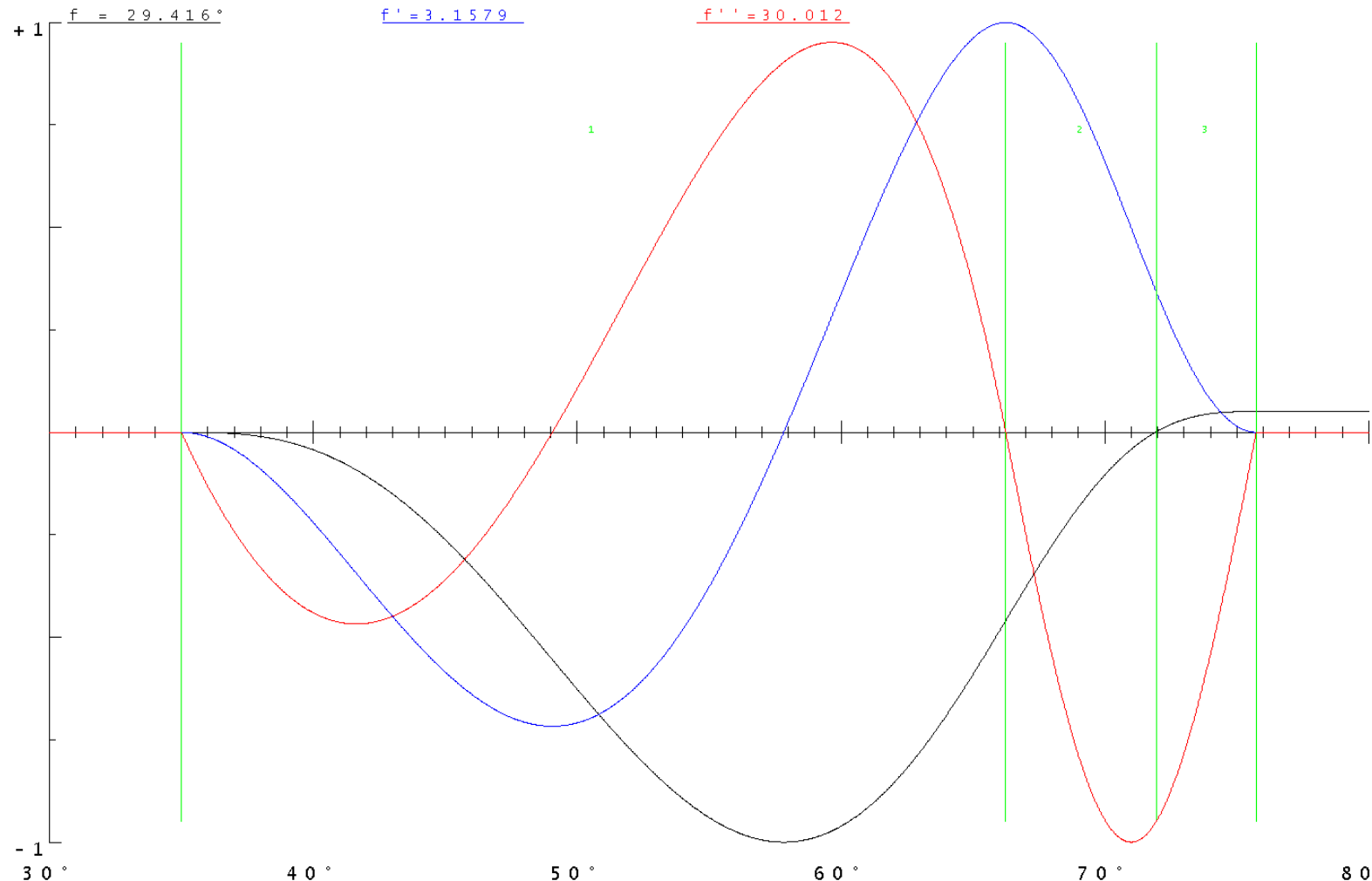
Gripper – processing function: transport

Transfer between cylinders



Standard laws of motion

Modelled movement for the gripperbar



Up to now:

Use of standard laws of motion characterized for example in:

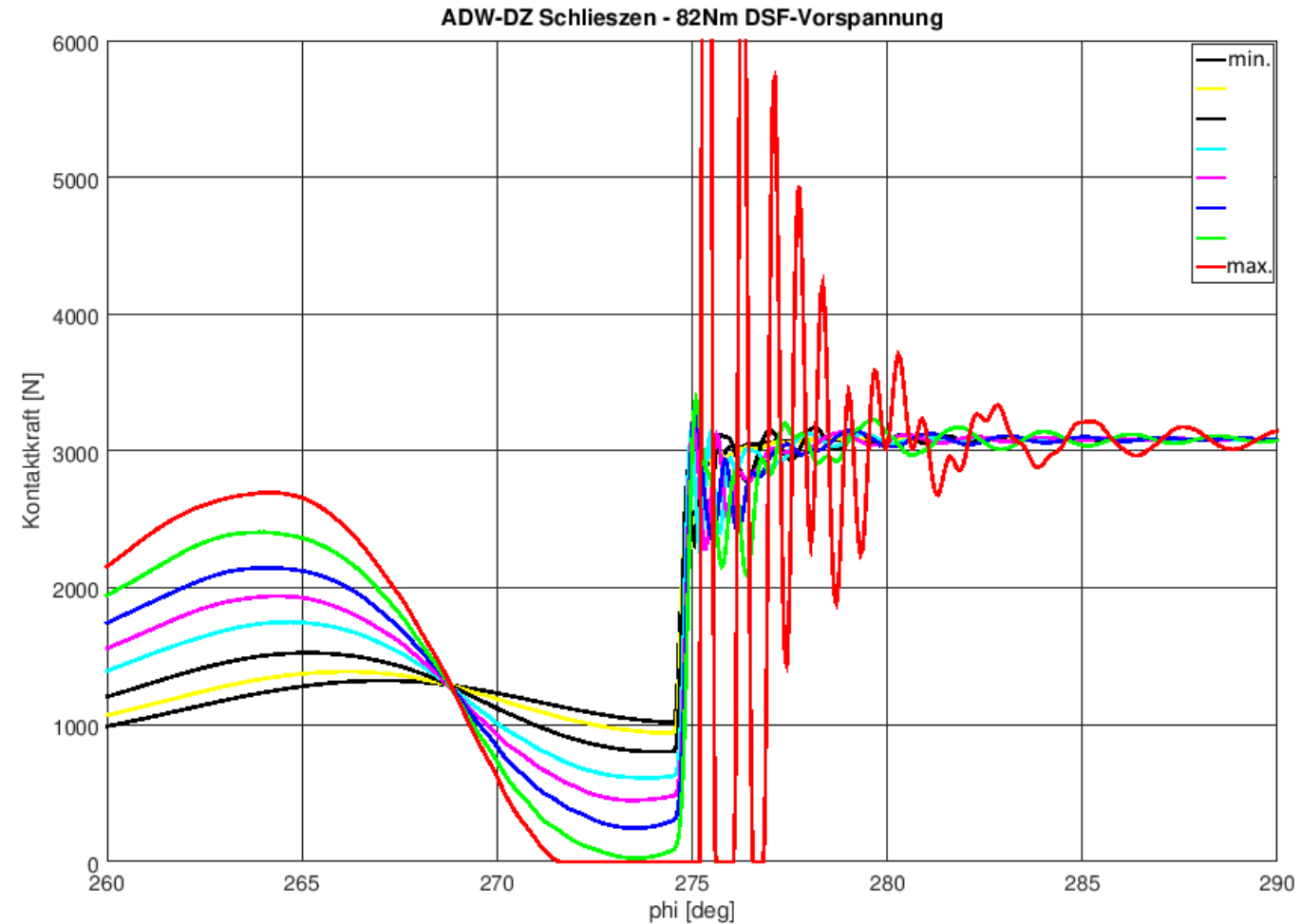
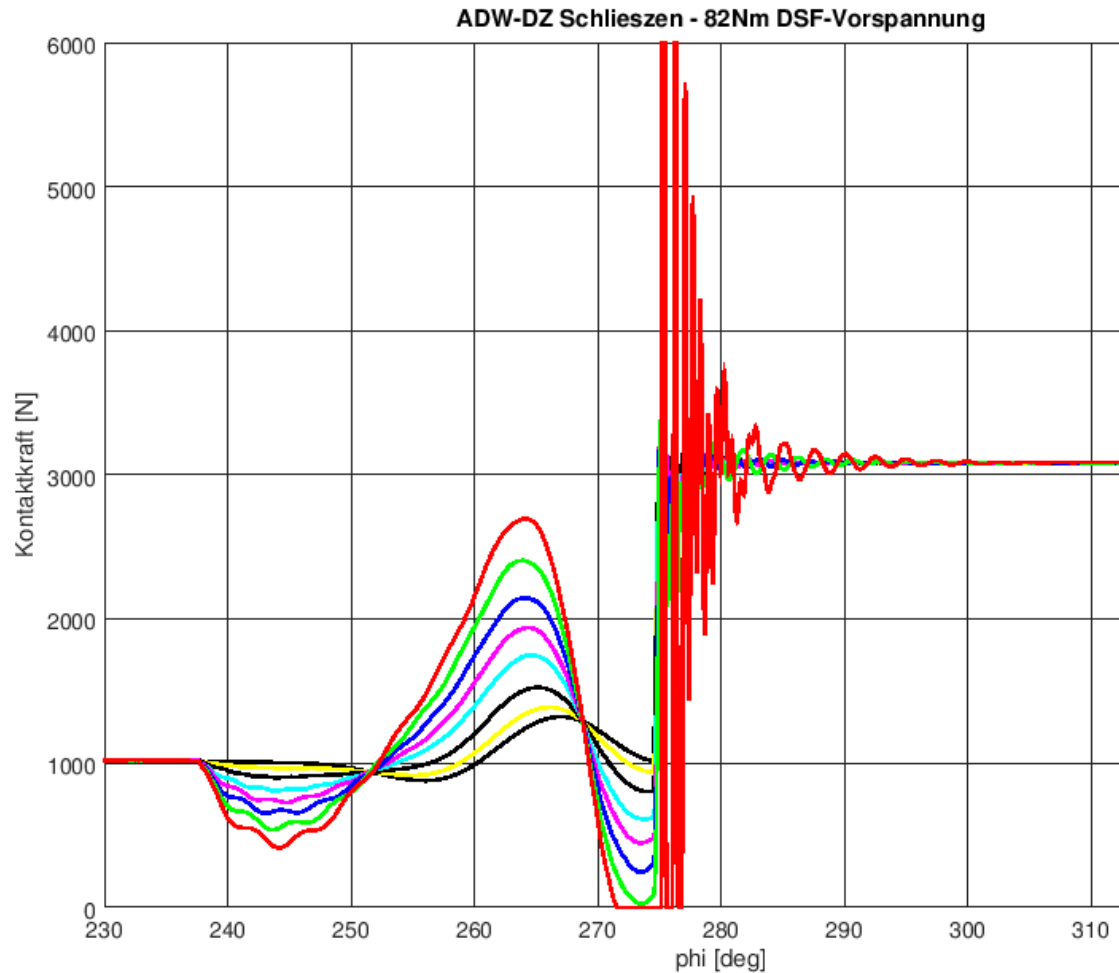
- VDI 2143,
- textbooks
- Software for example from Nolte ...

Example :

- Individual movement sections defined by boundary conditions
- → Polynomials as laws of motion

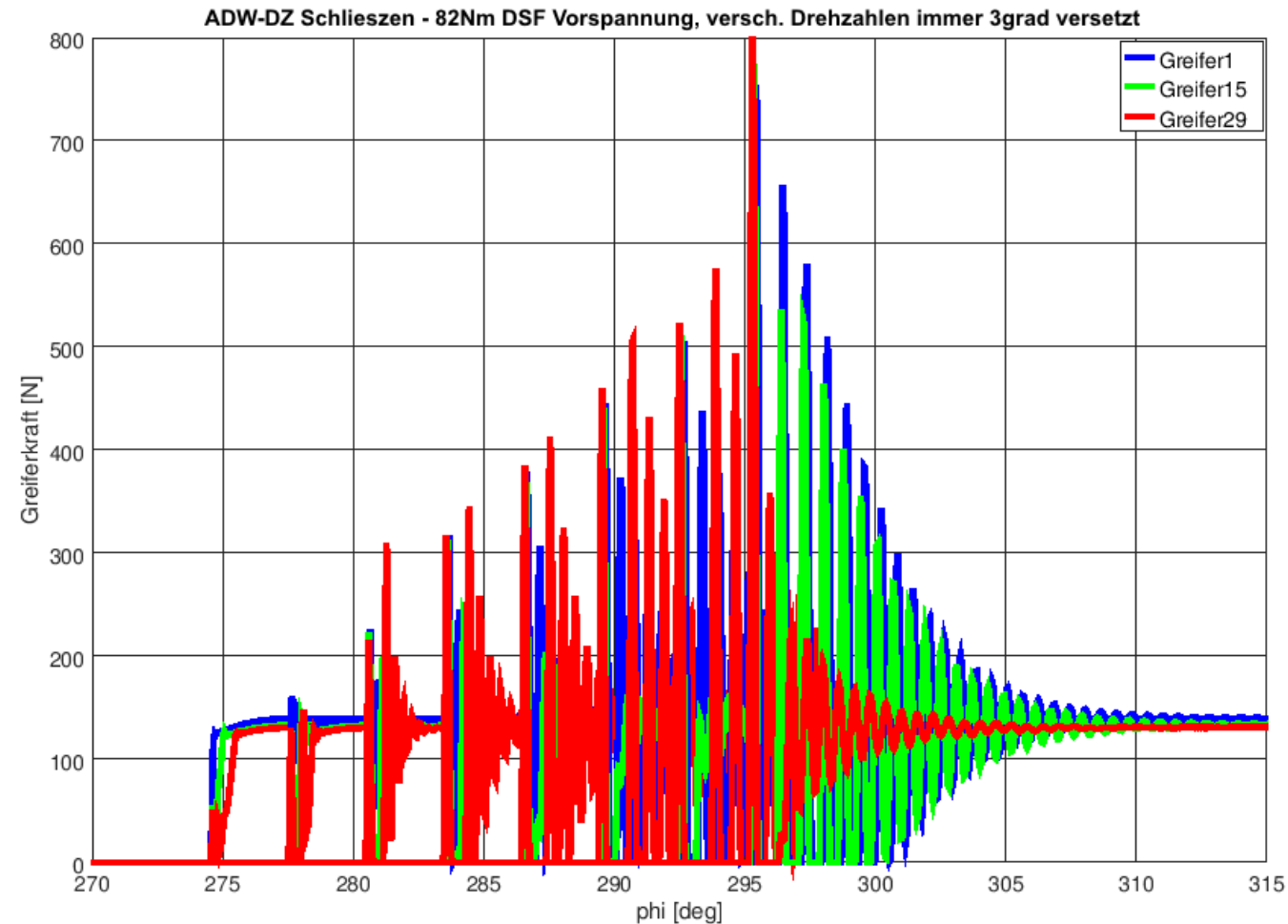
Standard laws of motion

Dynamical Response of the gripperbar - rollerforce

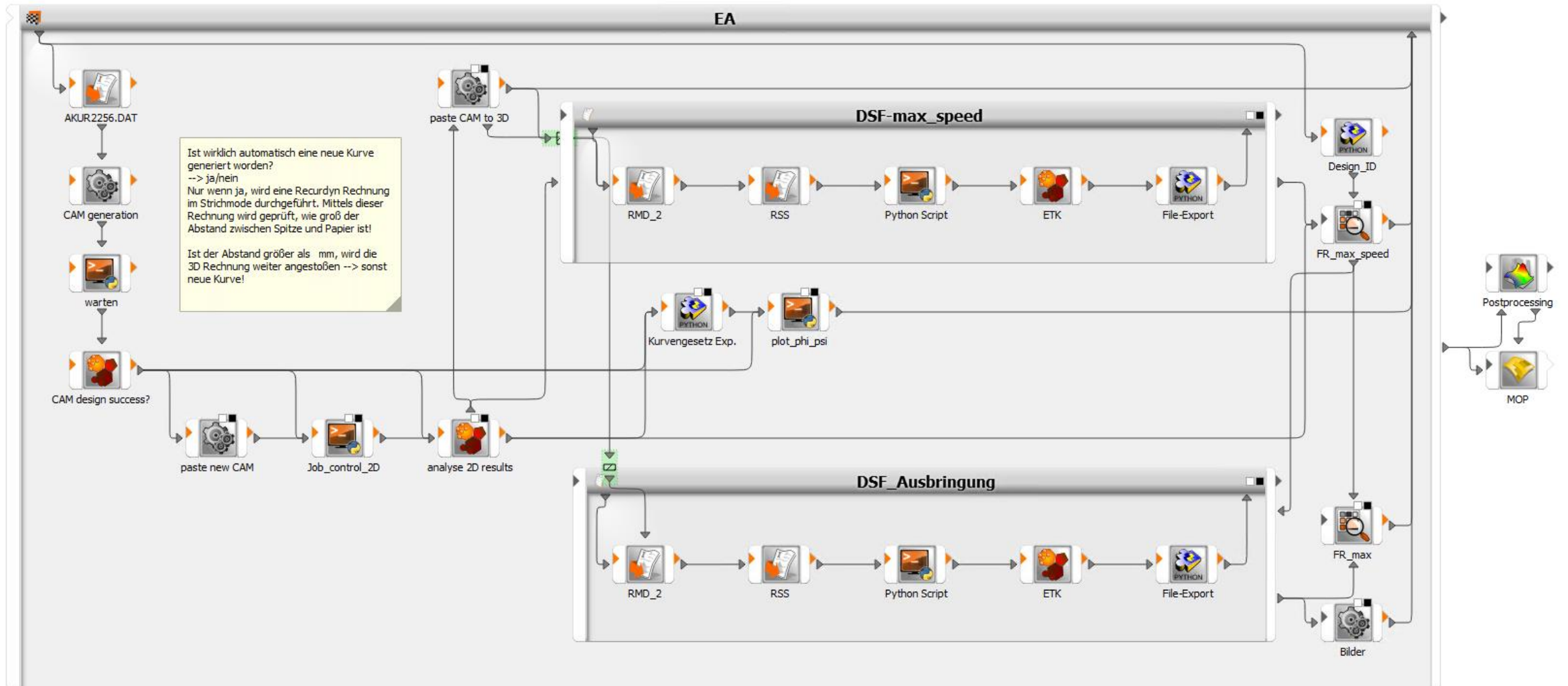


Standard laws of motion

Dynamical Response of the gripperbar - gripperforces

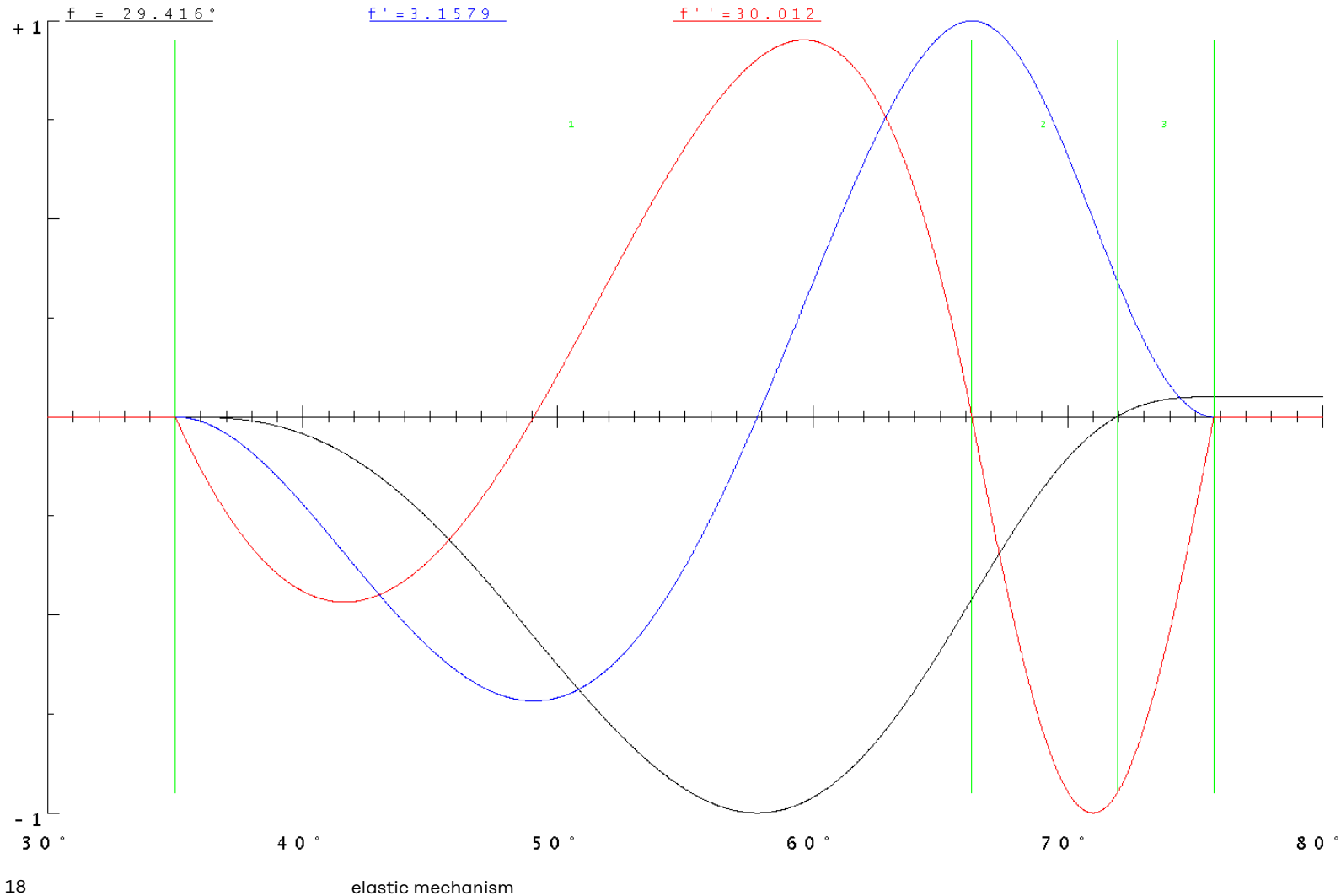


Optislang – Setup



Optislang

Parameters/Constraints/goals of Optimization



Parameters (12):

- Φ_{3a} fixed: (defined by functionality)
- Φ_{ig1} - Φ_{ig3} var. (3)
- BC for Ψ , Ψ' , Ψ'' , Ψ''' (9)

Constraints (2):

- min. distance between paperedge and gripper
- max. rollerforce

Goals (minimization (2)):

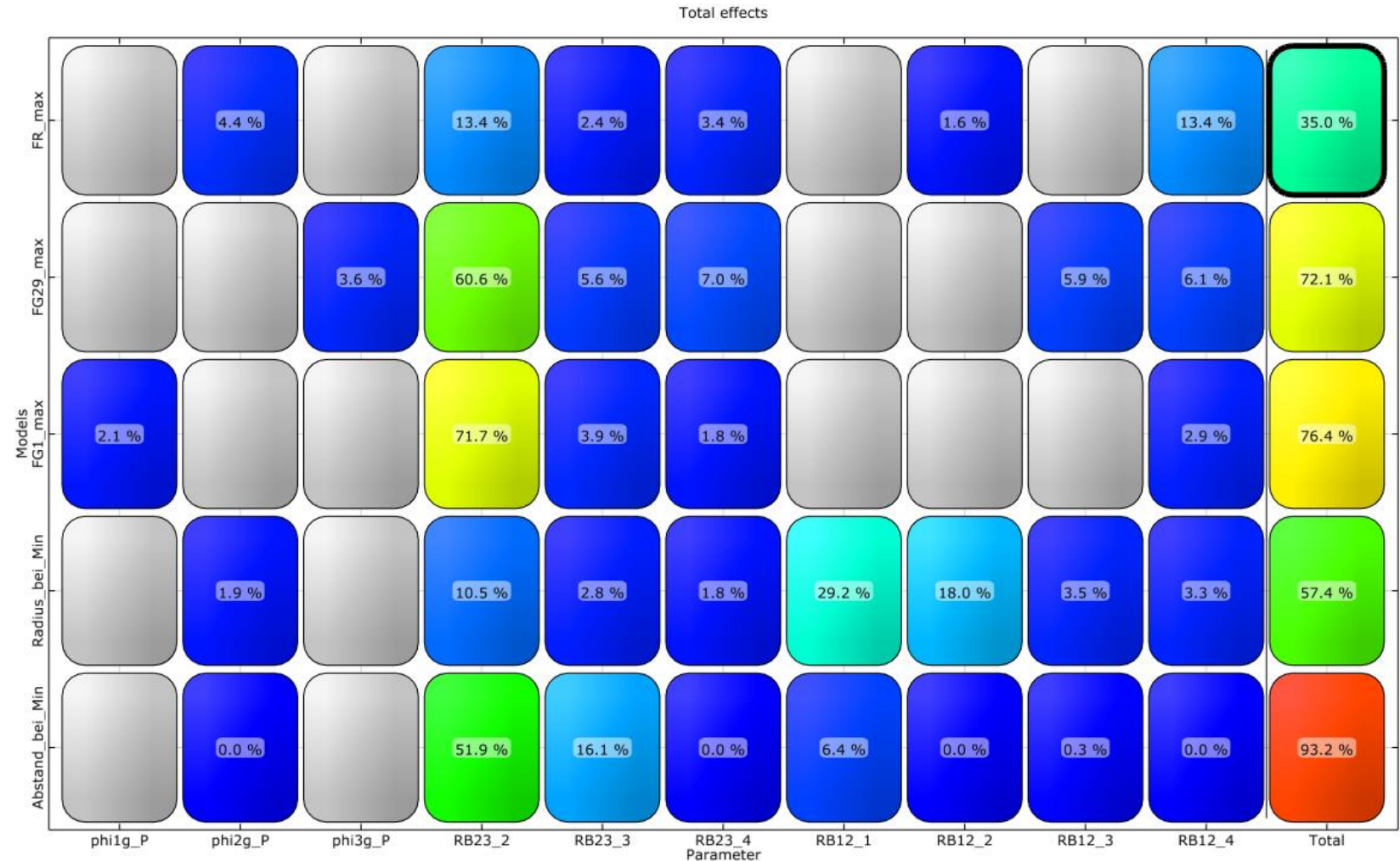
- rollerforce
- gripperforce

Optislang

Sensitivity analysis, 2000Sample, Adv. Latin Hypercube – COP Matrix for the metamodel

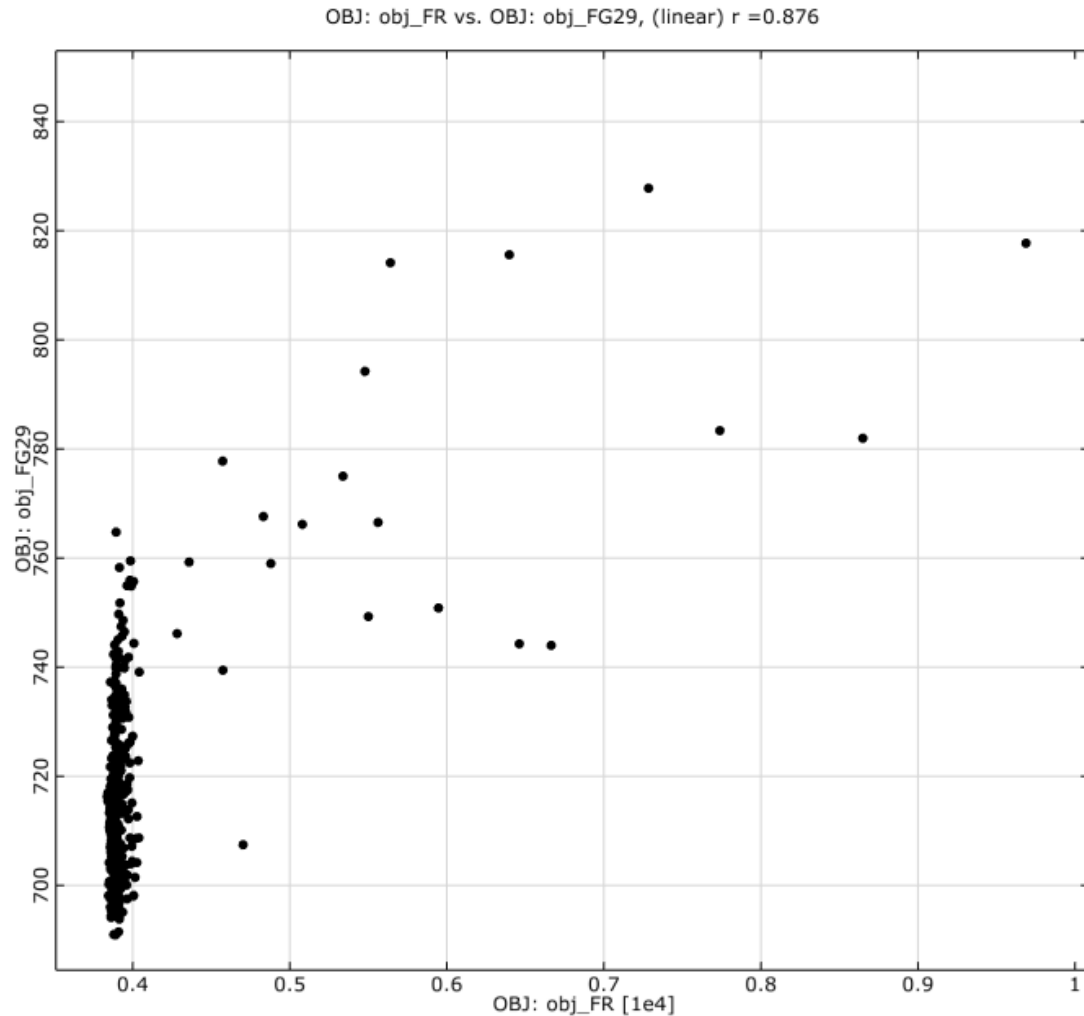
- just 230 valid solutions
- COP for FR_max is 35%
- COP for FG1_max resp. FG29_max ca. 74%

→ optimization with the MOP is not possible

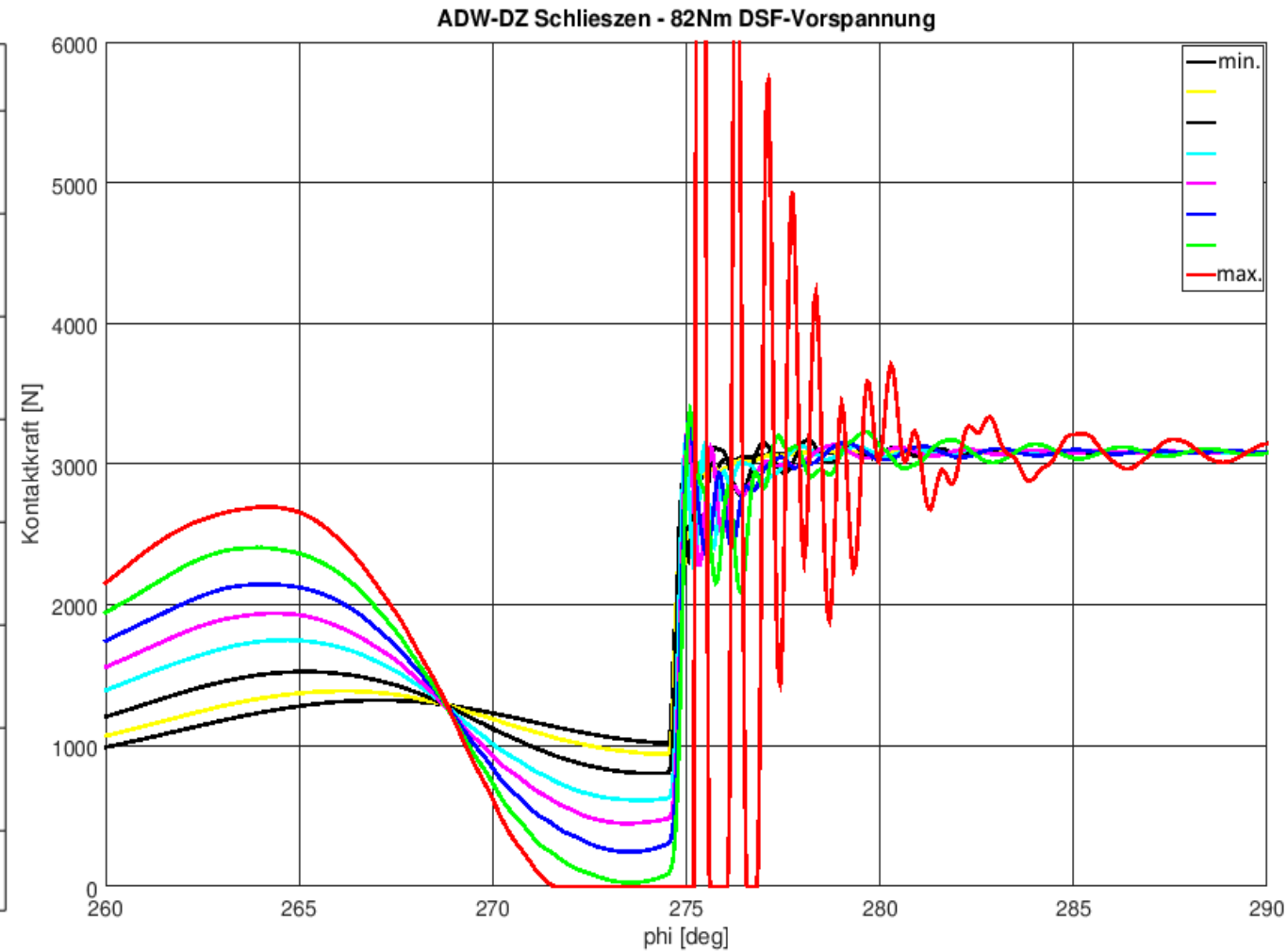


Optislang

Pareto Front – EA, 7 start-sets from previous sensitivity analysis → 361 valid solutions



elastic mechanism

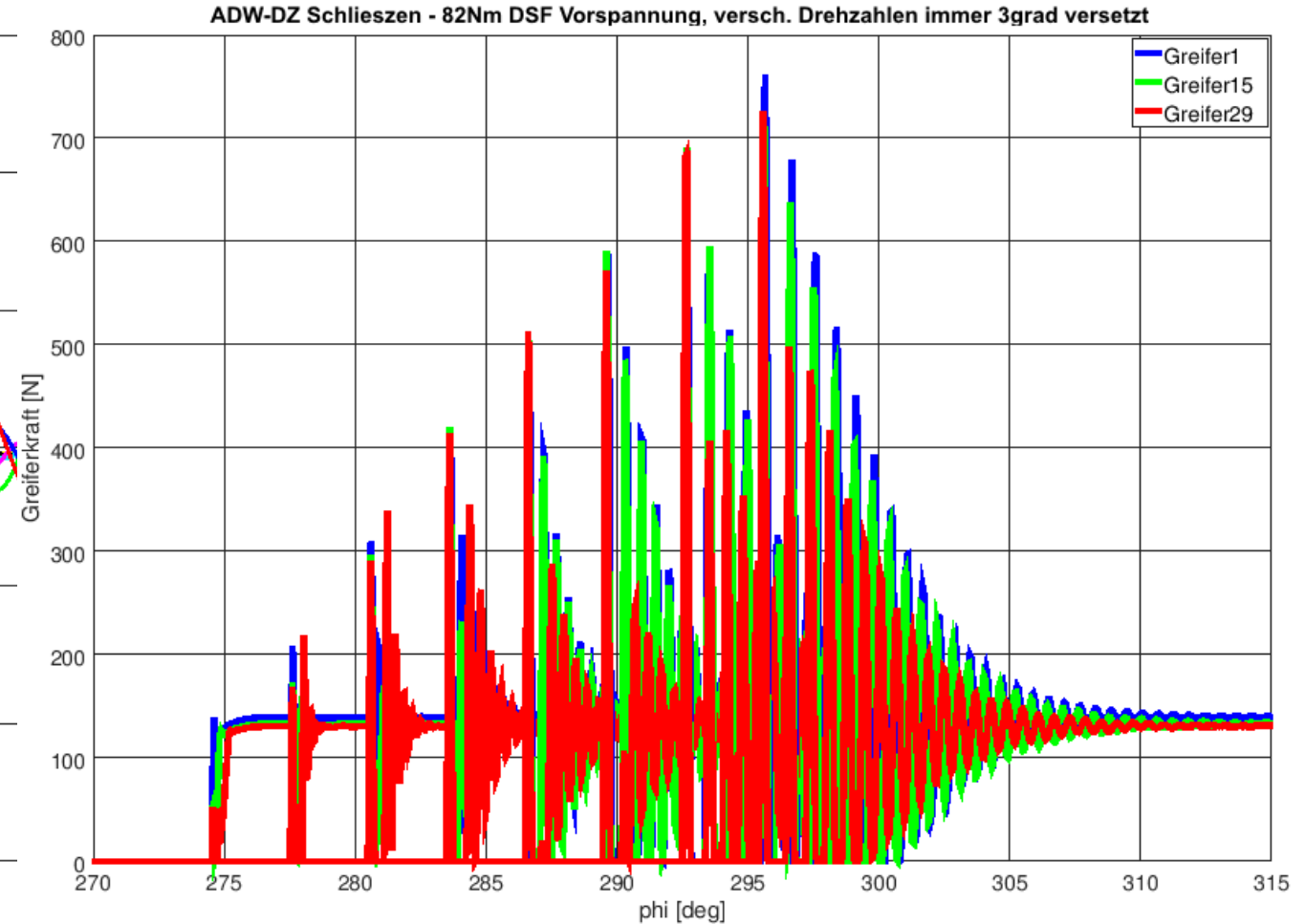
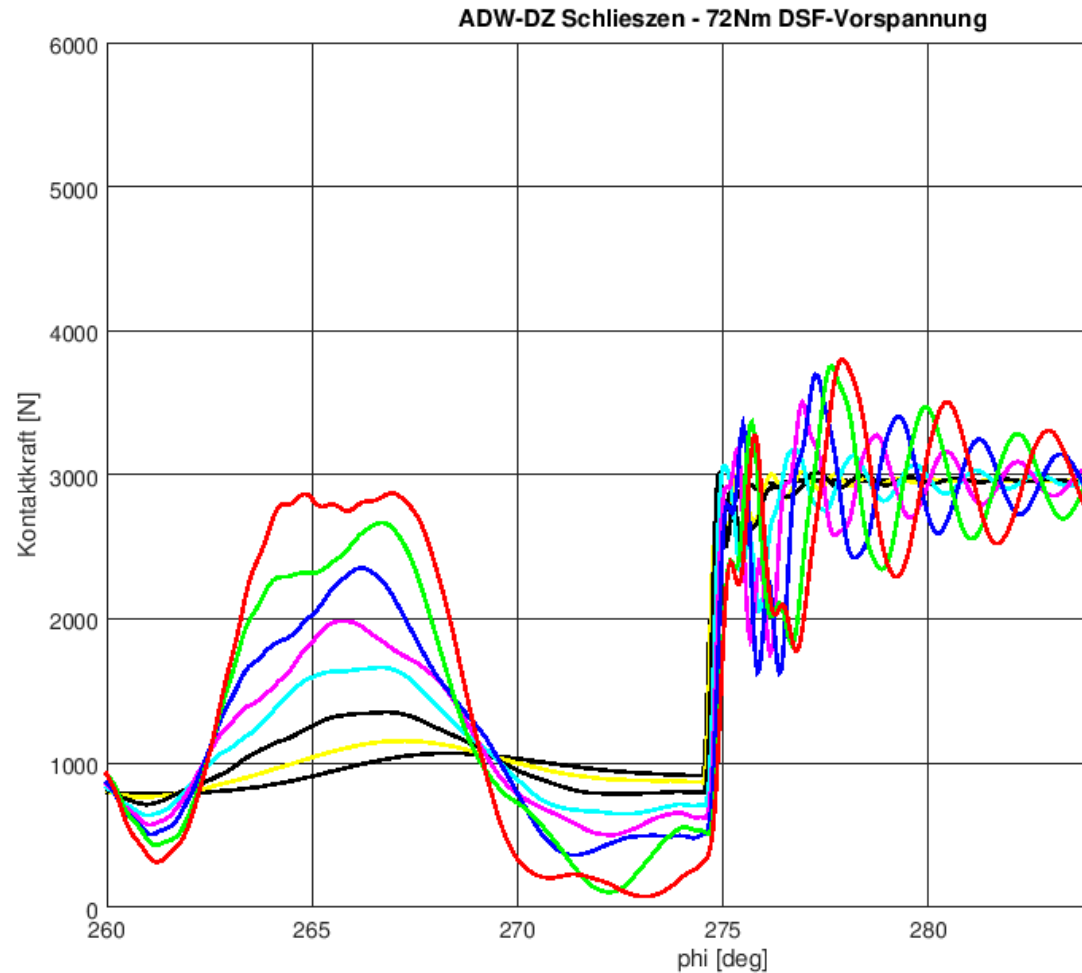


2019

Koenig & Bauer Sheetfed

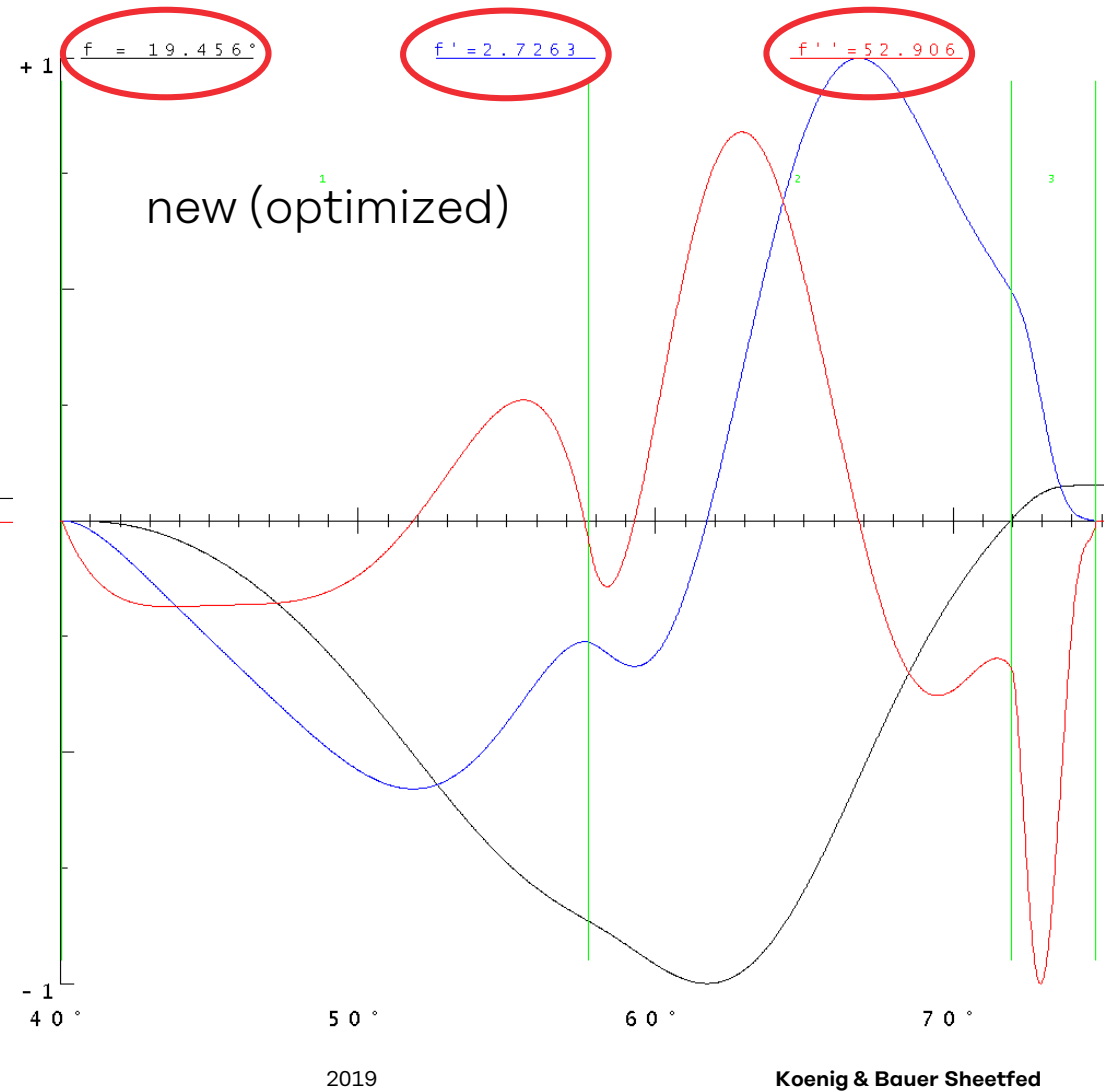
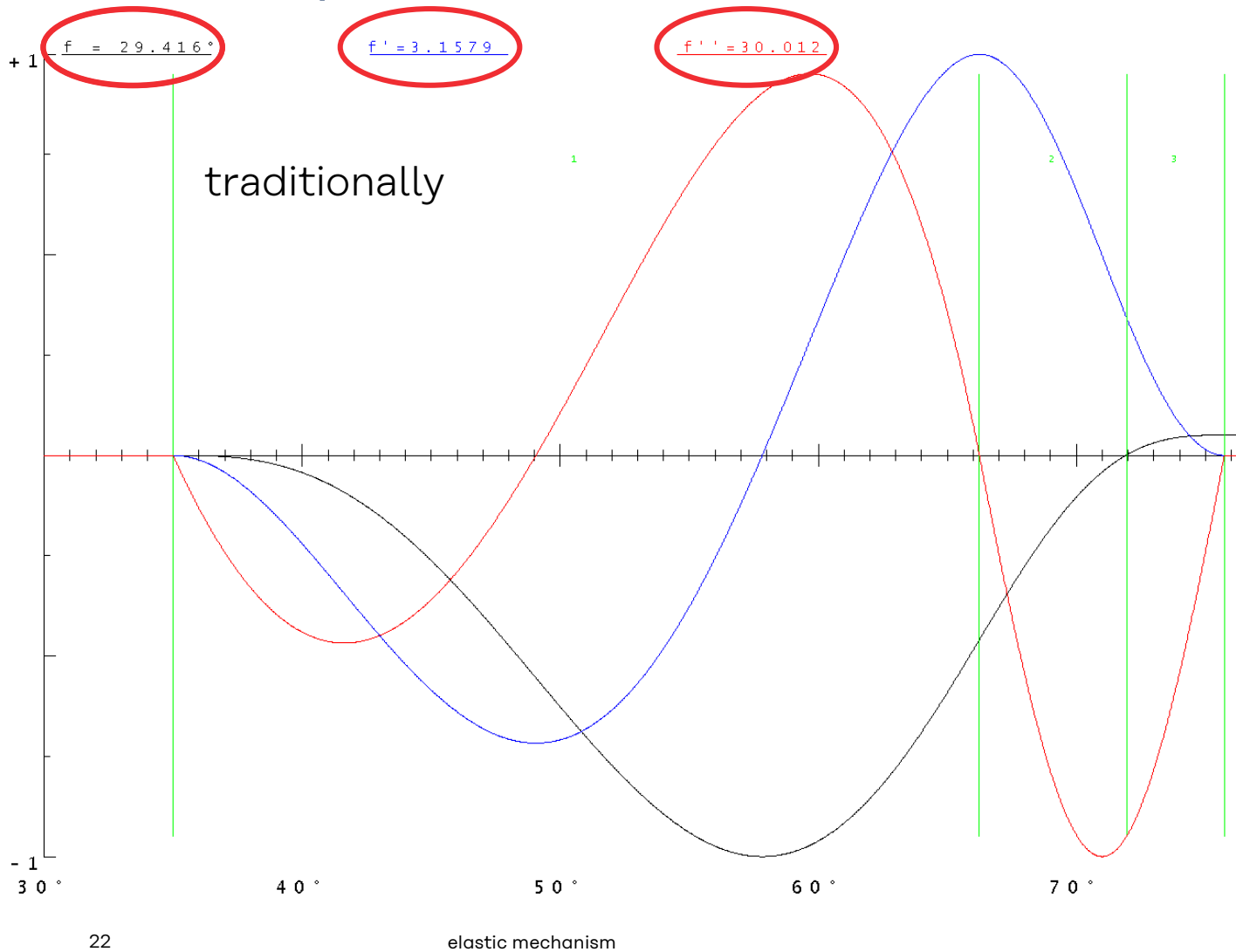
Optislang

Selected parameter set for the law of motion



Optislang

Selected parameter set for the law of motion



Optislang

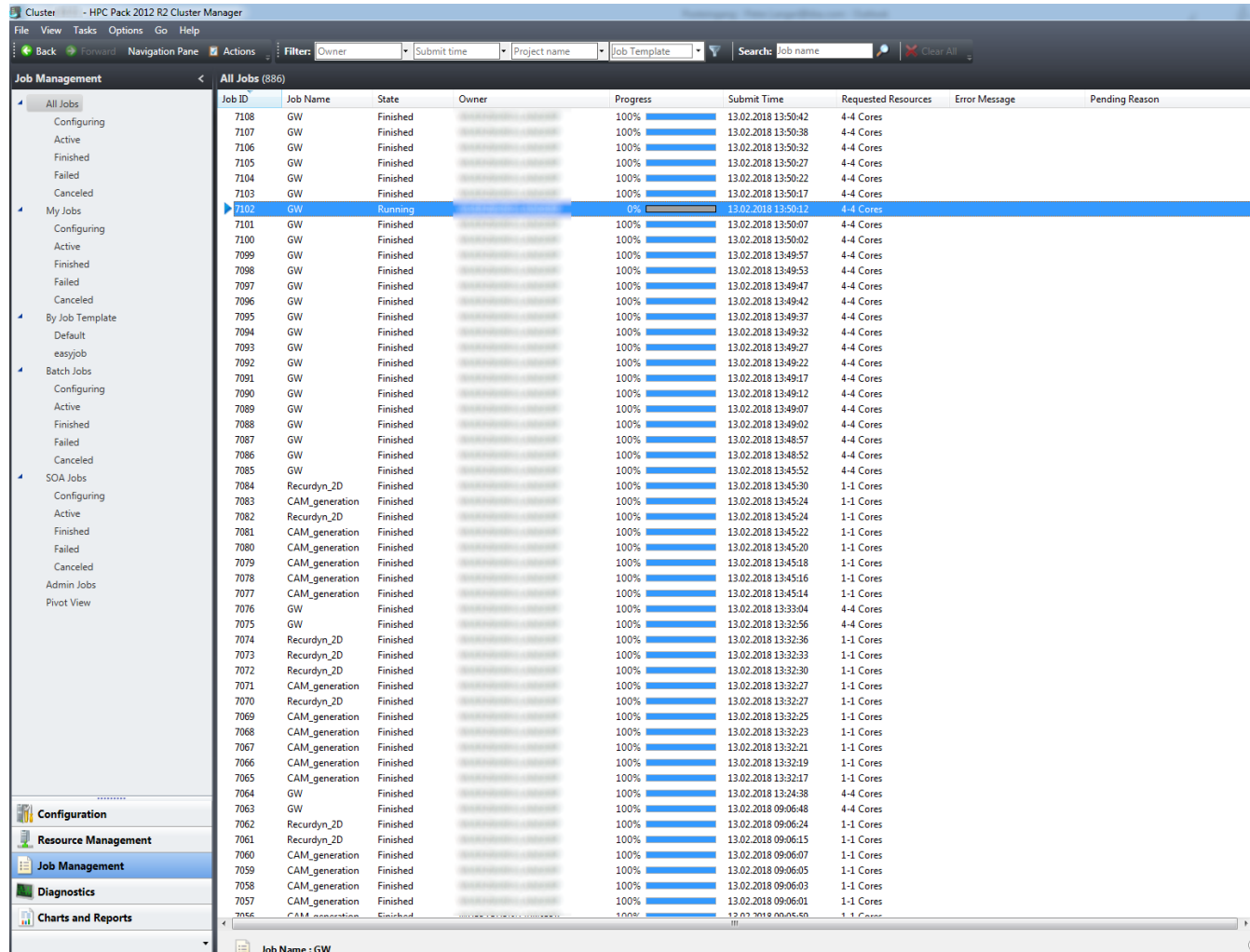
Solution time for the optimization

- EA: 361 sets
- one solution using Recurdyn is already optimized down to 2Min. (using 4 cores)
- 8 speeds and 3 different spring preloads → 24 solutions per parameter set
- 8664 calculations in Recurdyn → 17328 Min. → 289 hours on a system with 4 cores
- one XXL package Recurdyn includes 20 licenses – needs then 80 cores!

→ Using an HPC: Recurdyn calculations are done in 15 hours (the whole Optislang project)

High Performance Cluster - HPC

Windows: HPC Pack 2012R2



The screenshot shows the 'Job Management' window of the HPC Pack 2012 R2 Cluster Manager. The left sidebar contains a tree view with categories like 'All Jobs', 'My Jobs', 'By Job Template', 'Batch Jobs', 'SOA Jobs', 'Admin Jobs', and 'Pivot View'. The main pane displays a table of jobs with columns: Job ID, Job Name, State, Owner, Progress, Submit Time, Requested Resources, Error Message, and Pending Reason. The table lists numerous jobs, mostly in a 'Finished' state, with one job (7102) currently in a 'Running' state at 0% progress. The bottom status bar indicates 'Job Name : GW'.

Job ID	Job Name	State	Owner	Progress	Submit Time	Requested Resources	Error Message	Pending Reason
7108	GW	Finished		100%	13.02.2018 13:50:42	4-4 Cores		
7107	GW	Finished		100%	13.02.2018 13:50:38	4-4 Cores		
7106	GW	Finished		100%	13.02.2018 13:50:32	4-4 Cores		
7105	GW	Finished		100%	13.02.2018 13:50:27	4-4 Cores		
7104	GW	Finished		100%	13.02.2018 13:50:22	4-4 Cores		
7103	GW	Finished		100%	13.02.2018 13:50:17	4-4 Cores		
7102	GW	Running		0%	13.02.2018 13:50:12	4-4 Cores		
7101	GW	Finished		100%	13.02.2018 13:50:07	4-4 Cores		
7100	GW	Finished		100%	13.02.2018 13:50:02	4-4 Cores		
7099	GW	Finished		100%	13.02.2018 13:49:57	4-4 Cores		
7098	GW	Finished		100%	13.02.2018 13:49:53	4-4 Cores		
7097	GW	Finished		100%	13.02.2018 13:49:47	4-4 Cores		
7096	GW	Finished		100%	13.02.2018 13:49:42	4-4 Cores		
7095	GW	Finished		100%	13.02.2018 13:49:37	4-4 Cores		
7094	GW	Finished		100%	13.02.2018 13:49:32	4-4 Cores		
7093	GW	Finished		100%	13.02.2018 13:49:27	4-4 Cores		
7092	GW	Finished		100%	13.02.2018 13:49:22	4-4 Cores		
7091	GW	Finished		100%	13.02.2018 13:49:17	4-4 Cores		
7090	GW	Finished		100%	13.02.2018 13:49:12	4-4 Cores		
7089	GW	Finished		100%	13.02.2018 13:49:07	4-4 Cores		
7088	GW	Finished		100%	13.02.2018 13:49:02	4-4 Cores		
7087	GW	Finished		100%	13.02.2018 13:48:57	4-4 Cores		
7086	GW	Finished		100%	13.02.2018 13:48:52	4-4 Cores		
7085	GW	Finished		100%	13.02.2018 13:48:47	4-4 Cores		
7084	Recurdyn_2D	Finished		100%	13.02.2018 13:45:30	1-1 Cores		
7083	CAM_generation	Finished		100%	13.02.2018 13:45:24	1-1 Cores		
7082	Recurdyn_2D	Finished		100%	13.02.2018 13:45:24	1-1 Cores		
7081	CAM_generation	Finished		100%	13.02.2018 13:45:22	1-1 Cores		
7080	CAM_generation	Finished		100%	13.02.2018 13:45:20	1-1 Cores		
7079	CAM_generation	Finished		100%	13.02.2018 13:45:18	1-1 Cores		
7078	CAM_generation	Finished		100%	13.02.2018 13:45:16	1-1 Cores		
7077	CAM_generation	Finished		100%	13.02.2018 13:45:14	1-1 Cores		
7076	GW	Finished		100%	13.02.2018 13:33:04	4-4 Cores		
7075	GW	Finished		100%	13.02.2018 13:32:56	4-4 Cores		
7074	Recurdyn_2D	Finished		100%	13.02.2018 13:32:36	1-1 Cores		
7073	Recurdyn_2D	Finished		100%	13.02.2018 13:32:33	1-1 Cores		
7072	Recurdyn_2D	Finished		100%	13.02.2018 13:32:30	1-1 Cores		
7071	CAM_generation	Finished		100%	13.02.2018 13:32:27	1-1 Cores		
7070	Recurdyn_2D	Finished		100%	13.02.2018 13:32:27	1-1 Cores		
7069	CAM_generation	Finished		100%	13.02.2018 13:32:25	1-1 Cores		
7068	CAM_generation	Finished		100%	13.02.2018 13:32:23	1-1 Cores		
7067	CAM_generation	Finished		100%	13.02.2018 13:32:21	1-1 Cores		
7066	CAM_generation	Finished		100%	13.02.2018 13:32:19	1-1 Cores		
7065	CAM_generation	Finished		100%	13.02.2018 13:32:17	1-1 Cores		
7064	GW	Finished		100%	13.02.2018 13:24:38	4-4 Cores		
7063	GW	Finished		100%	13.02.2018 09:06:48	4-4 Cores		
7062	Recurdyn_2D	Finished		100%	13.02.2018 09:06:24	1-1 Cores		
7061	Recurdyn_2D	Finished		100%	13.02.2018 09:06:15	1-1 Cores		
7060	CAM_generation	Finished		100%	13.02.2018 09:06:07	1-1 Cores		
7059	CAM_generation	Finished		100%	13.02.2018 09:06:05	1-1 Cores		
7058	CAM_generation	Finished		100%	13.02.2018 09:06:03	1-1 Cores		
7057	CAM_generation	Finished		100%	13.02.2018 09:06:01	1-1 Cores		
7056	CAM_generation	Finished		100%	13.02.2018 09:05:59	1-1 Cores		

configuration of HPC:

- Head node: VM, Server2012R2
- 3 Compute nodes: in total 80 cores, Server2012R2
- Fileserver für HPC: 8 cores, 20TB, Server2012R2

In addition:

- Workstation as frontend for the long OptislangRuns

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