GUNT TECHNOLOGY LIMITED

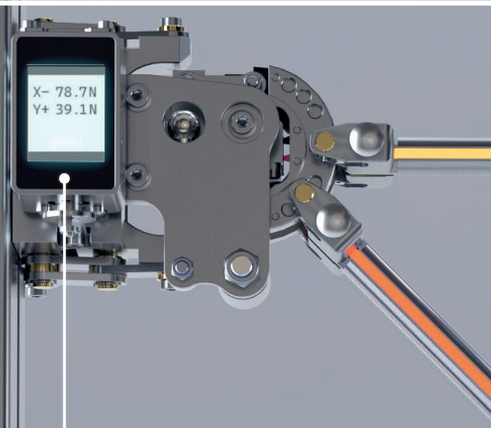
SE 200 | MEC Line
Engineering mechanics

Didactic concept for experiments in statics and strength of materials

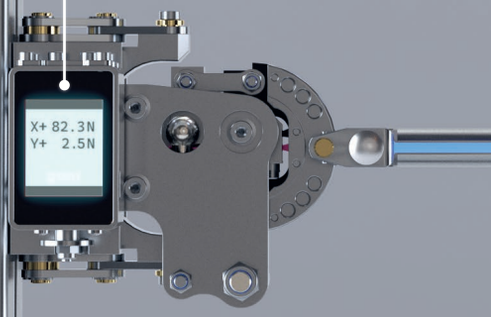
- smart, communication-enabled components
- wireless digital connection

Table of contents

Didactics and methodology	04
Smart data flow	06
Structure of the MEC Line	08
Smart components	10
Accessories	12
SE 200.01 MEC – Forces in trusses	14
SE 200.02 MEC – Forces on a suspension bridge	16
SE 200.05 MEC – Cable forces and pulley blocks	18
GUNT Science Media Center	20



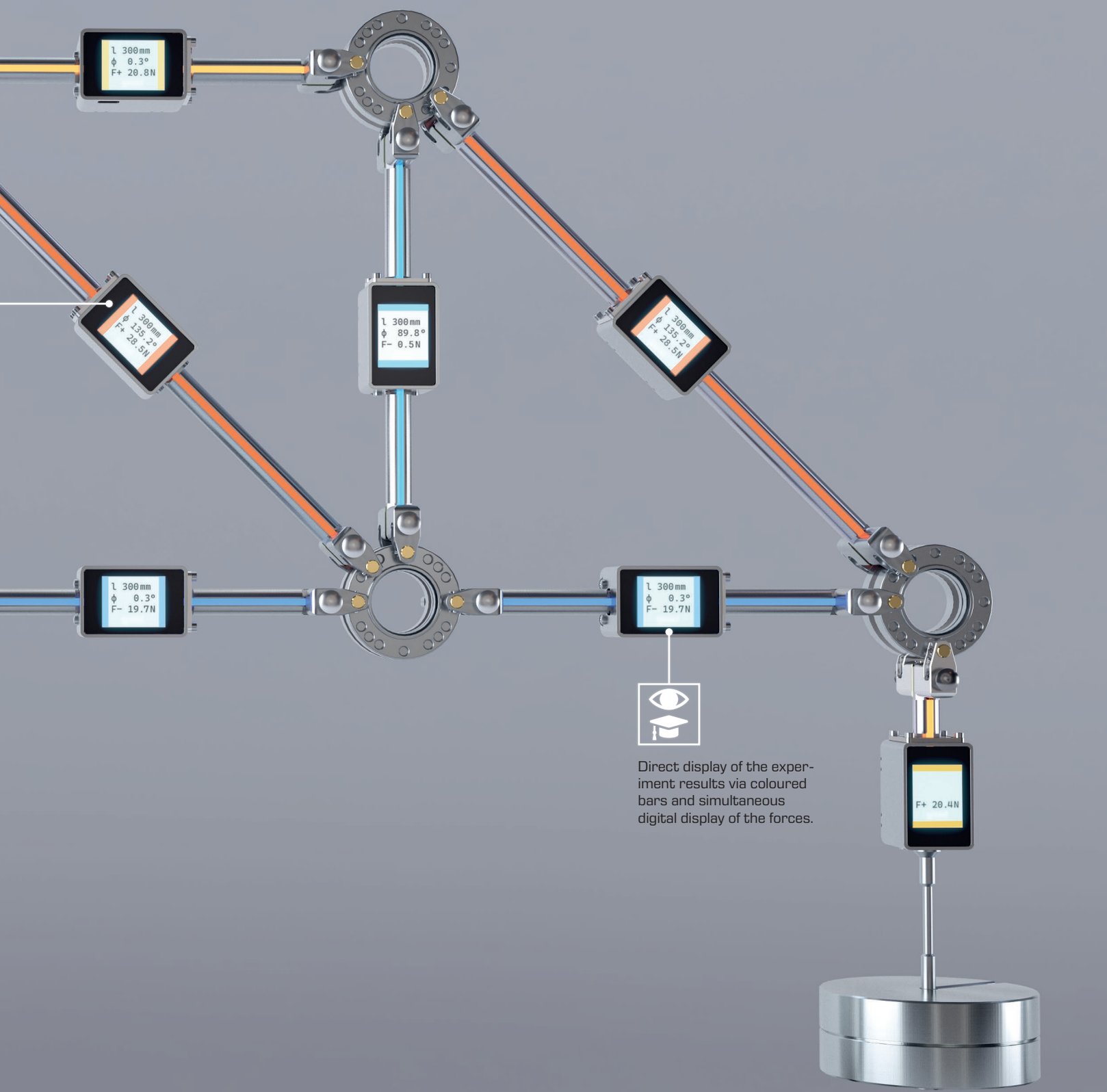
Smart, communication-enabled components with electronic module for direct data acquisition and measured value display.



Custom GUNT software with content adapted to the individual experiments enables real-time display and analysis.

The GUNT Science Media Center provides technical descriptions, manuals, exercises, videos and E-Learning courses with fundamental knowledge, theory and calculations for all experiments.

Precise and resilient frame structure. The click system enables a simple, quick experimental setup without cabling.



Direct display of the experiment results via coloured bars and simultaneous digital display of the forces.

Didactics and methodology

Experiments using all the senses – for an in-depth learning experience

Develop the fundamentals of engineering mechanics according to textbook and curriculum in experiments

What

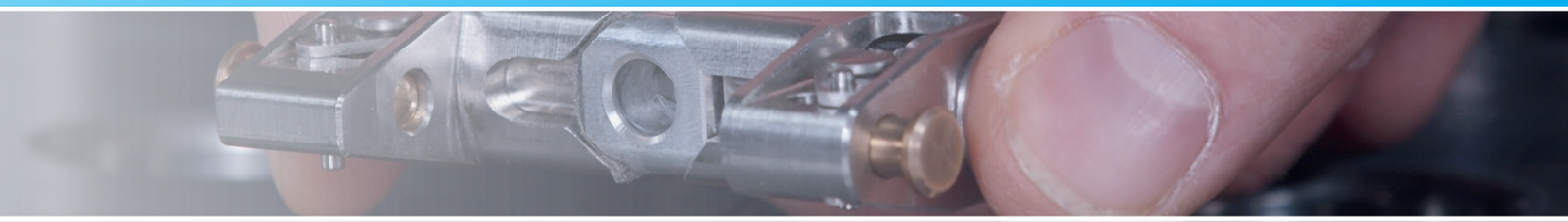
- static systems in equilibrium of forces
- trusses: internal reaction and support reaction under external loads
- elastic reactions under external loads
- analysis of typical elements from civil engineering: beams, bridges
- familiarisation with stability problems

Haptic experience

- promotes the comprehension and internalisation of learning content through the sense of touch
- manual work and skill in setting up experiments
- no disruptive cabling of the individual elements
- sturdy components with click system, quick and easy to assemble

Experimental learning

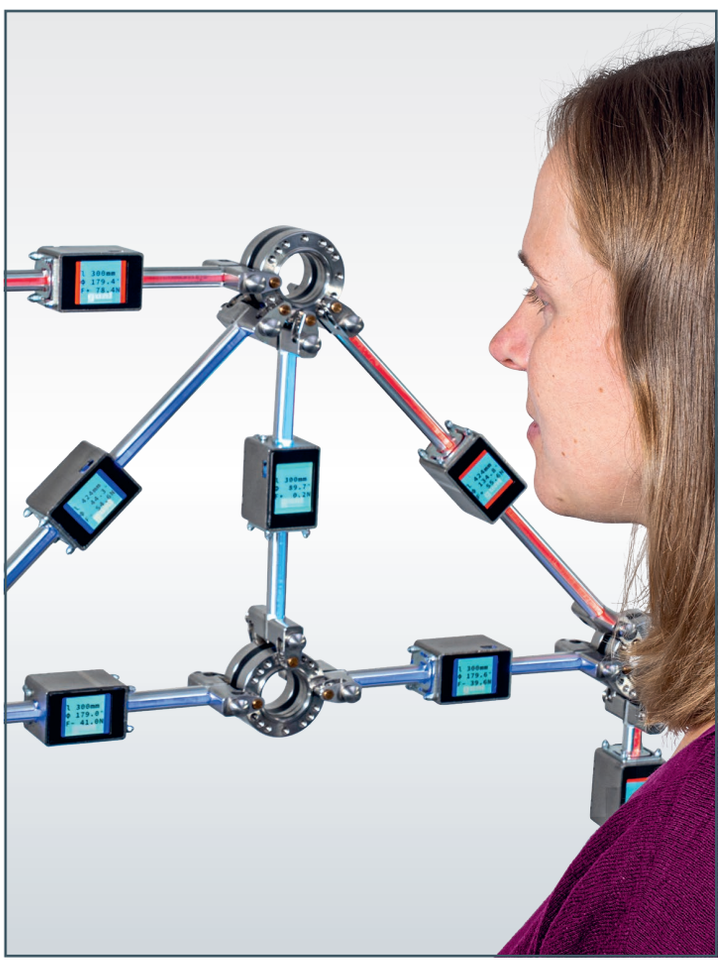
- promotes self-directed learning and effective teamwork
- accessories of the series can be combined in a modular way for setup and extension of the experiments
- possibility to create your own experiments with many variations



Familiarisation with digital concepts and methods of measurement technology and data processing simultaneously

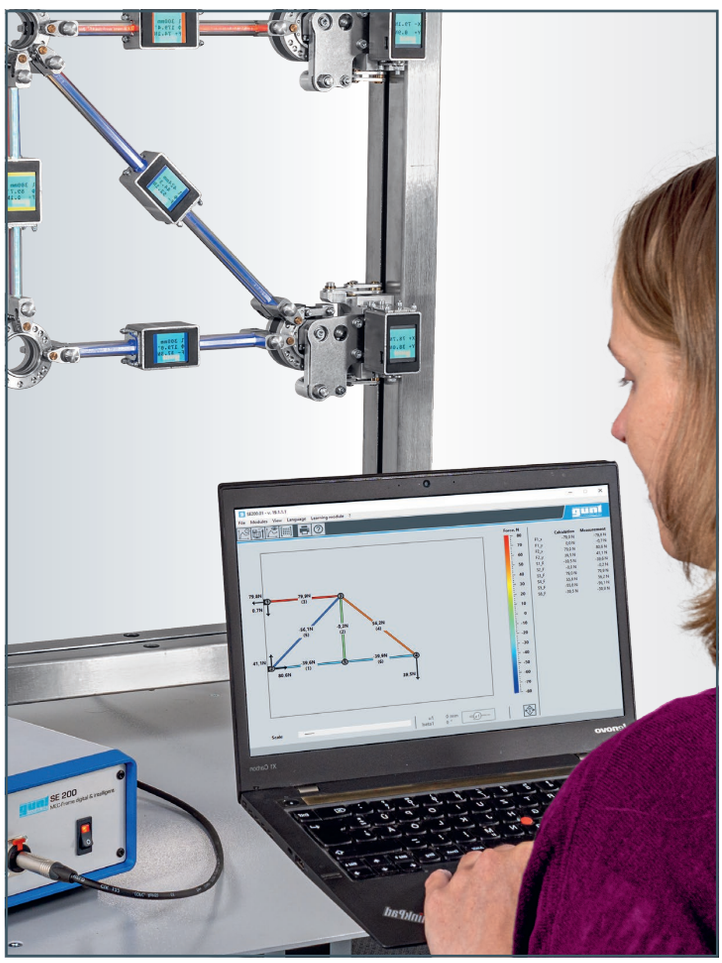
How

- implement theoretical teaching topics in experiments by planning series of experiments and setting up your own experiments
- technically realise terms such as fixation or articulated support
- coloured display of forces, display of the loading as well as automatic topology transmission for direct feedback
- microprocessor-based measurement technology for force and angle, distance, position and identification
- application of Gray codes (reflected binary, RB)
- integration of FEM models, strength verification, etc.



Visual comprehension

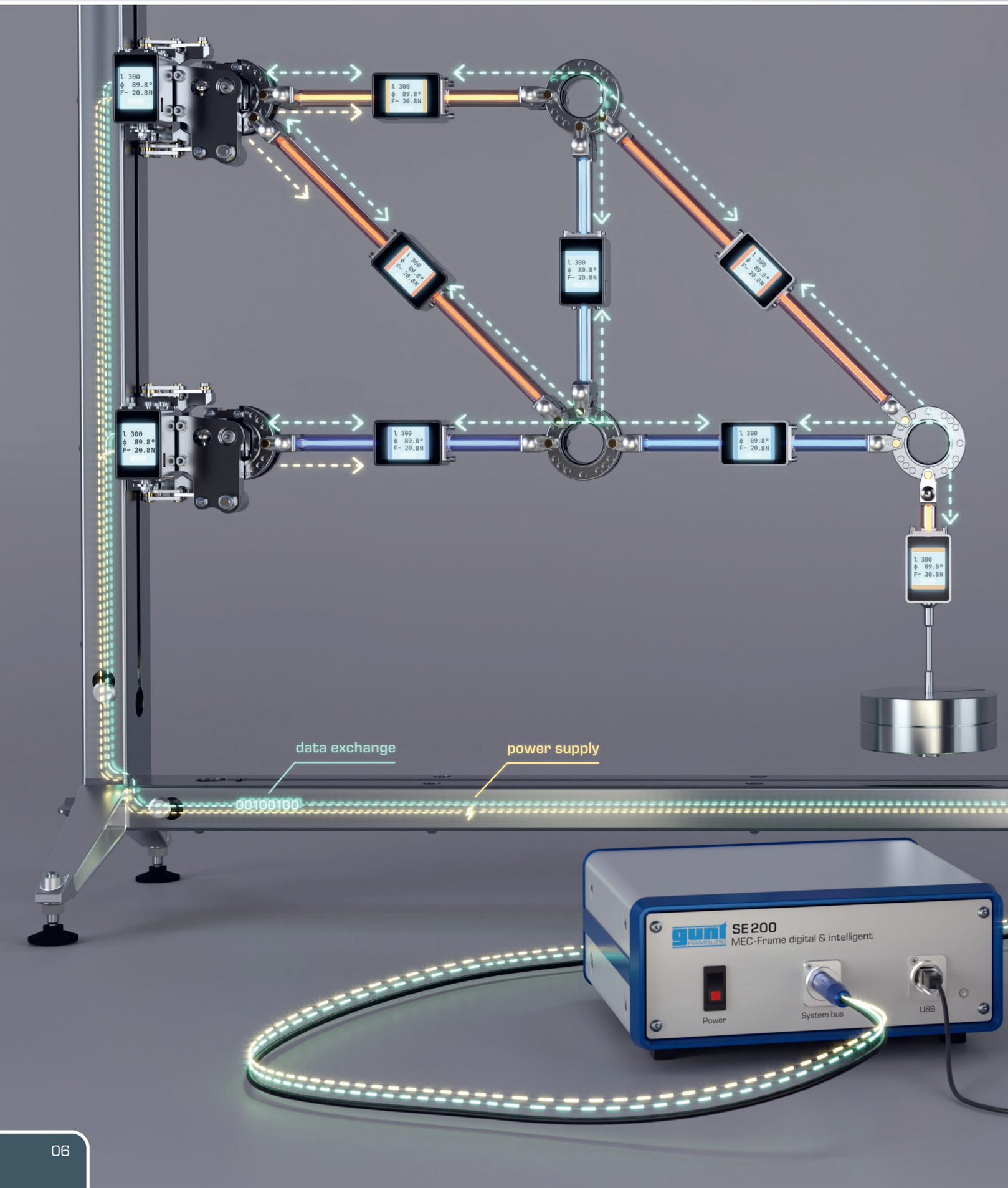
- promotes abstraction skills
- visual representation of experimental processes that are otherwise invisible and can only be understood through calculation



Logical thinking

- promotes the recognition of interrelationships through the transmission of topology
- analysis of measurement results and estimation of errors

Smart data flow –
wireless information and power supply



tensile load
compressive load
neutral
data exchange
power supply
Plug & Play
SE200.01 - v. 19.1.1.1
File Modules View Language Learning module ?
Force, N
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Calculation Measurement
F1_x -79,2 N -80,4 N
F1_y 39,6 N 38,3 N
F2_x 79,2 N 80,7 N
F2_y -0,0 N -2,0 N
S1_F -79,2 N -80,3 N
S2_F -39,4 N -42,2 N
S3_F 39,6 N 39,9 N
S4_F 55,9 N 56,1 N
S5_F 56,0 N 57,5 N
S6_F -39,6 N -39,5 N
38,3N
80,4N
39,9N
(3)
57,5N
(5)
-42,2N
(2)
56,1N
(4)
-80,3N
(1)
-39,5N
(6)
2,0N
80,7N
39,6N
Scale
u1
beta1
0 mm
0 °

Structure of the MEC Line

Full experimental setups are created from the mounting frame and the components for experiments, setup and measurement technology. The experiments are accompanied by software for real-time visualisation, measurement data acquisition and analysis.

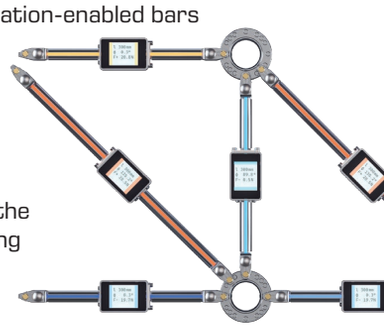
MEC – Frame: digital & smart

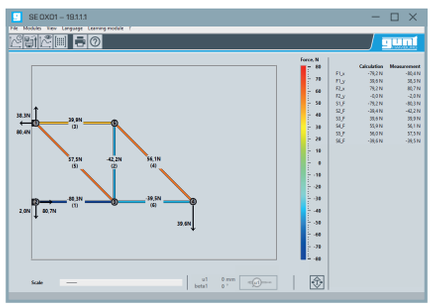
Mounting frame to hold smart, communication-enabled components with a master module for digital connection and measurement data acquisition

Components for experiments in statics and strength of materials as accessories

- smart, communication-enabled bars with electronic module
- bridge components and beams
- pulley blocks, etc.

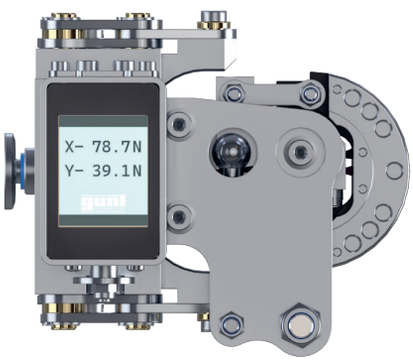
All components for the experiments including GUNT software

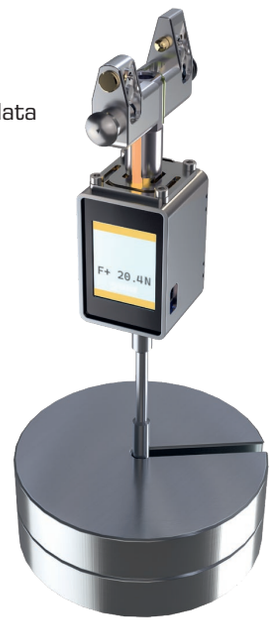


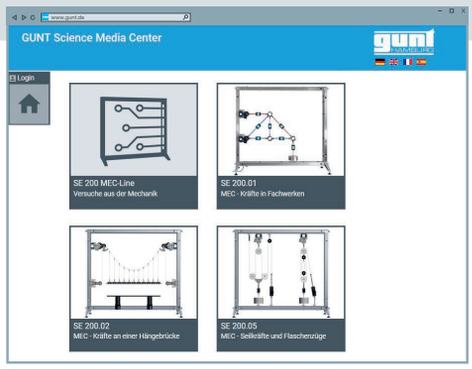


Components for the setup and measurement technology as accessories

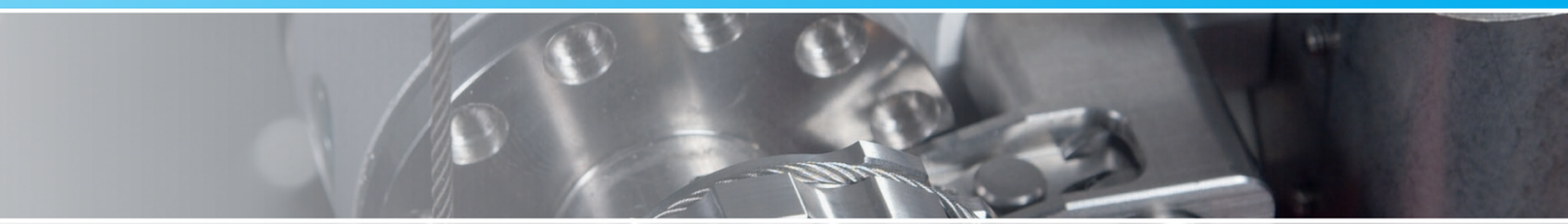
Smart, communication-enabled loads, supports, distance measurement etc. equipped with an electronic module for data acquisition and measured value display

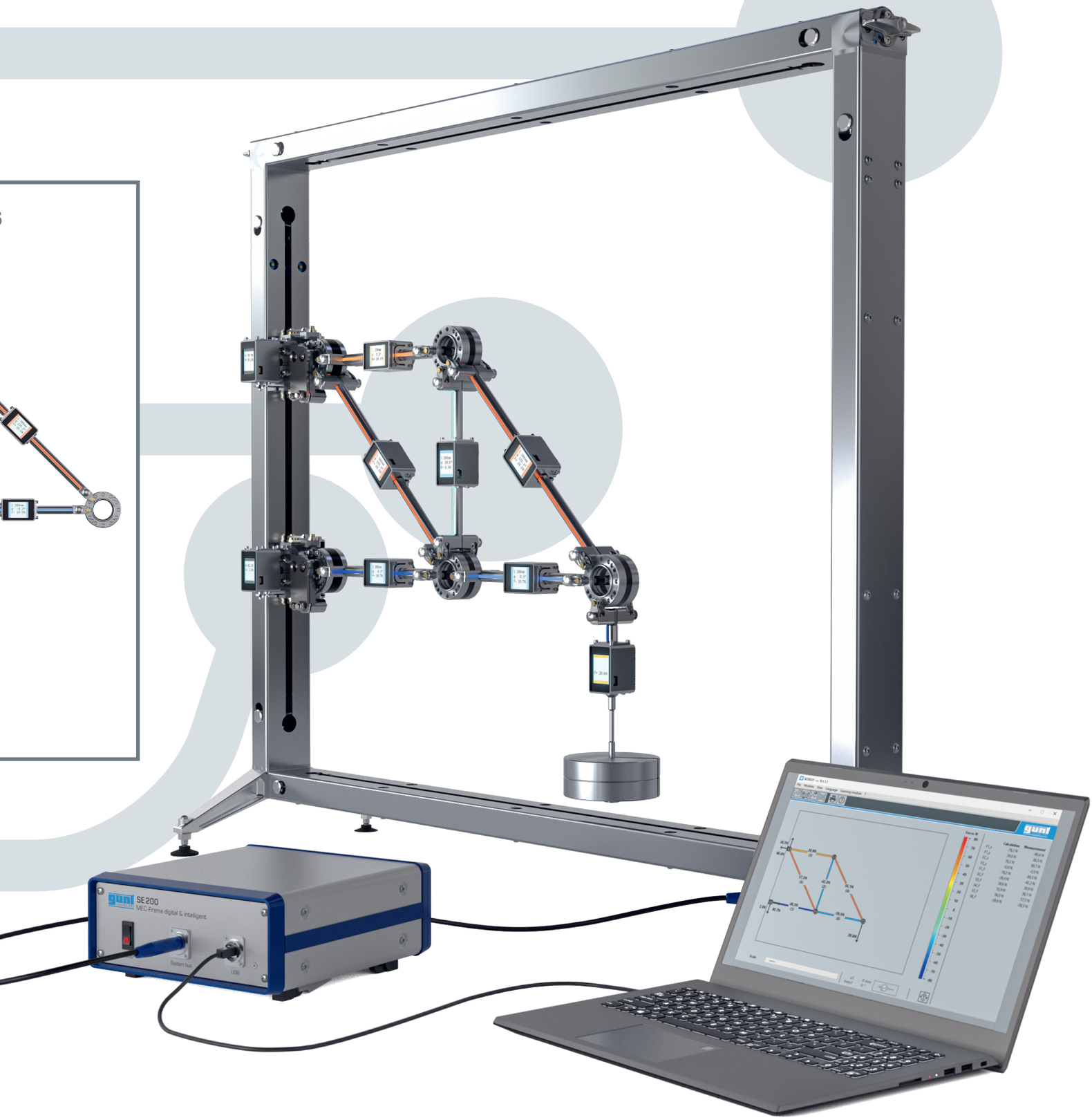






Access to the GUNT Science Media Center



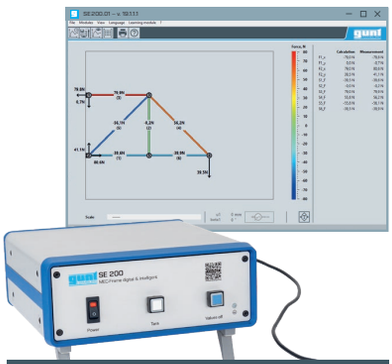

gunt
SE200
MEC-Frame digital & intelligent
System bus
USB

Smart, communication-enabled components for the setup and measurement technology

Components for the setup

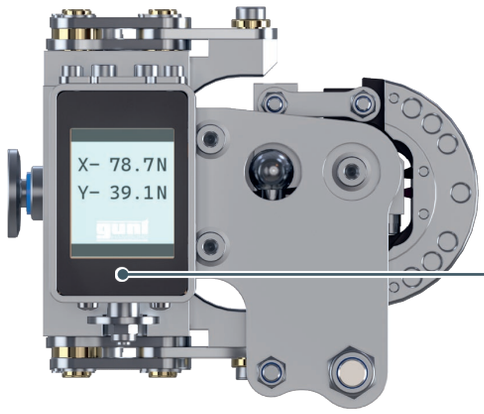
Mounting frame

- base element for setting up versatile experiments
- click system for easy setup and reconfiguration, no tools required
- stainless steel hollow sections with integrated electrical cable
- defined snap-in points for exact topology determination and transmission



Master module and software

- master module detects all data from the electronic modules and transmits it to the GUNT software via USB
- automatic identification of the smart, communication-enabled components including position and alignment
- master module connected via Plug&Play and only 1 power BUS line



Support

- fixed support for connecting smart, communication-enabled components via click system
- horizontal or vertical installation at different positions in the mounting frame
- automatic detection of the installation position and dynamic adjustment in the GUNT software

Electronic module

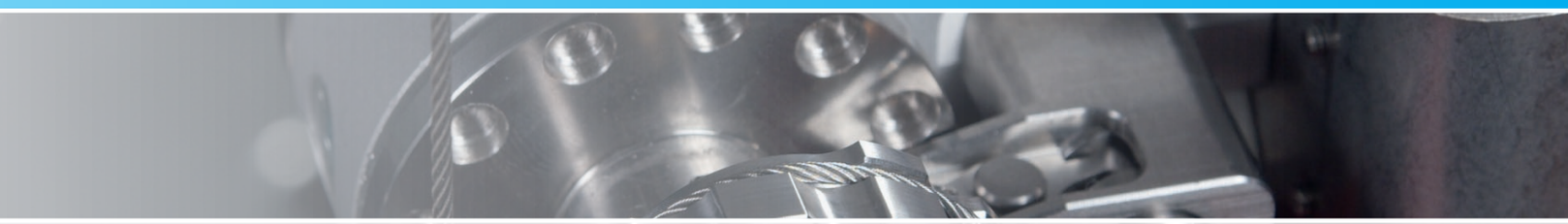
- equipped with planar beam load cells for direct force measurement in x, y direction
- integrated acceleration sensor for angle measurement for correct display of the geometry

Bar

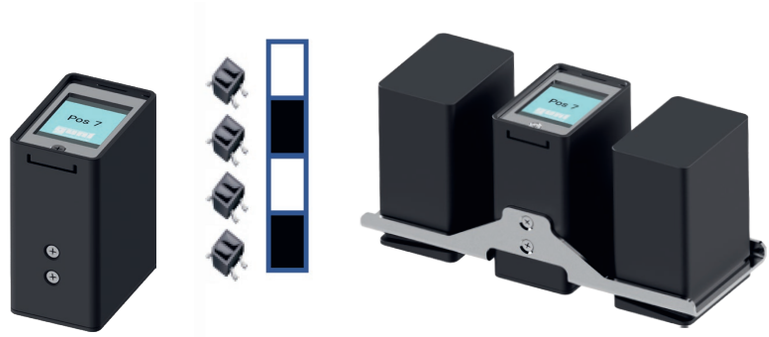
- tool-free setup and reconfiguration of various trusses without cabling
- force displayed as a measured value and as coloured illumination directly on the bar
- bars with articulated connection to node disks; loading only on compression or tension

Electronic module

- equipped with planar beam load cell for direct force measurement in the x direction
- communication in both bar directions to determine topology
- integrated acceleration sensor for angle measurement for correct display of the geometry



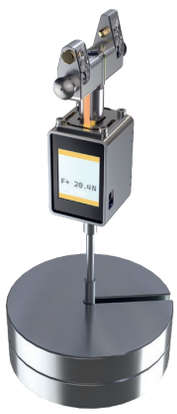
Components for measurement technology



Load

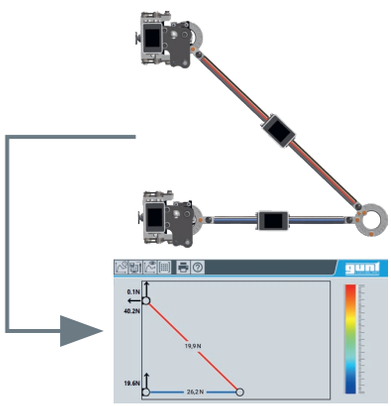
- generation of weight forces through concentrated load
- generation of line loads by combining several load elements
- **electronic module** with Gray code reader for position detection and transmission to the GUNT software

Line load



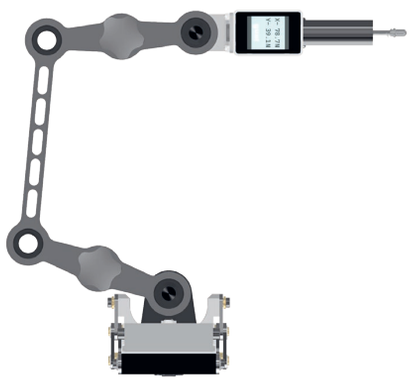
Vertical load

- various weights included in delivery
- visual representation of the force as coloured illumination
- **electronic module** contains Planar Beam load cell for direct force measurement; transfer of position using topology



Topology

- real-time transmission of the topology to the geometry display in the GUNT software
- exact visualisation of the experiments during setup
- special algorithm for topology transmission, developed by GUNT



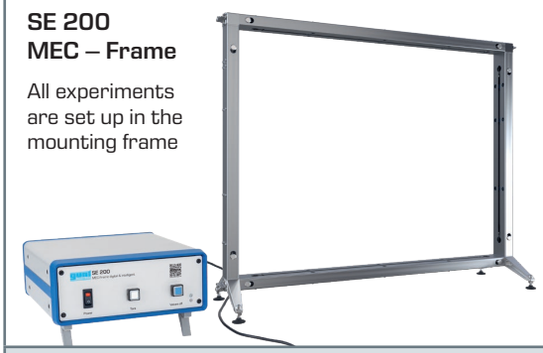
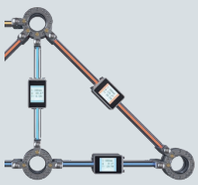
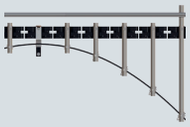
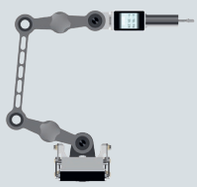
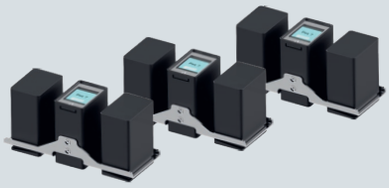
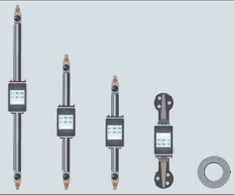
Distance measurement

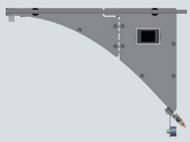
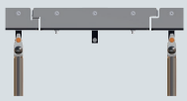
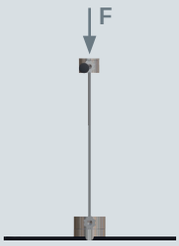
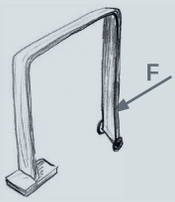
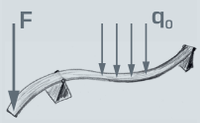
- articulated arm with long reach
- **electronic module** contains linear potentiometer for detecting paths and an acceleration sensor for detecting the measuring direction

Load unit

- stepless generation of tensile and compressive forces in any direction
- visual representation of force
- **electronic module** contains Planar Beam load cell for direct force measurement and an acceleration sensor to detect the measuring direction

Accessories

SE 200 MEC – Frame All experiments are set up in the mounting frame 	SE 200.01 Forces in trusses 	SE 200.02 Forces on a suspension bridge	SE 200.03 Parabolic arch bridge 	SE 200.04 Friction on the inclined plane
SE 200.21 Support	2	2	2	–
SE 200.22 Load unit	max. 2	–	–	–
SE 200.23 Distance measurement 	max. 1	–	2	–
SE 200.24 Vertical load	min. 1 max. 2	–	max. 1	–
SE 200.25 Load (Set of 5)	–	1	1	–
SE 200.26 Distributed load (Set of 3) 	–	max. 1	max. 1	–
SE 200.27 Bar set 	any quantity	–	–	–

SE 200.05 Cable forces and pulley blocks	SE 200.06 Three-hinged arch	SE 200.07 Gerber beam	SE 200.08 Buckling	SE 200.09 Deformation of frames	SE 200.10 Torsion of bars	SE 200.11 Elastic line of beams
						
min. 1 max. 2	2	2	–	2	–	2
–	–	–	1	1	–	1
–	–	–	min. 1 max. 2	min. 1 max. 2	–	min. 1 max. 2
min. 1 max. 2	1	max. 1	–	1	–	max. 1
–	1	1	–	–	–	–
–	max. 1	max. 1	–	–	–	–
–	–	–	–	–	–	–

SE 200.01 MEC – Forces in trusses

- smart, communication-enabled bars with electronic modules for data acquisition and measured value display
- setup of various trusses without cabling
- automatic identification and assignment of the bars in the GUNT software
- measured values and coloured display of the force directly on the bar
- calculated displacement of the truss can be magnified in the software

Learning objectives

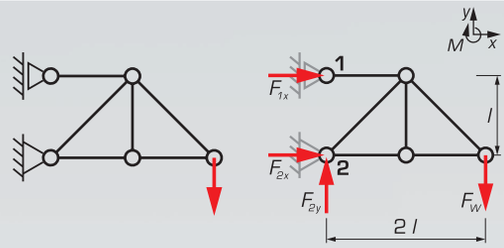
- measurement of the bar forces in a statically determinate and statically indeterminate plane truss
- dependence of bar forces on the external force
- comparison of measurement results with mathematical solution methods
- basic principle: using strain gauge technology to measure forces

Exercises

1 Setup of any truss with at least 6 bars and 1 load

- exact recording of the geometry with real-time transmission to the GUNT software
- measured values displayed directly on the bar, can be hidden if required

2 Calculation of external forces: loading by load, reaction of the supports



Simplified sketch for the constructed truss

Freeing the support forces

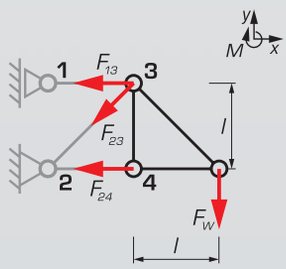
$$\sum F_x = F_{1x} + F_{2x} = 0$$

$$\sum F_y = F_{2y} + F_w = 0$$

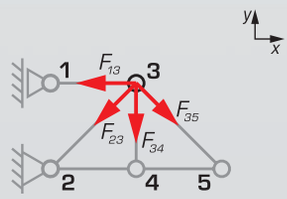
$$\sum M_2 = F_{1x} \cdot l + F_w \cdot 2 \cdot l = 0$$

Setting up the equilibrium conditions

3 Calculation of internal forces: select and apply method of joints or Ritter's method of sections

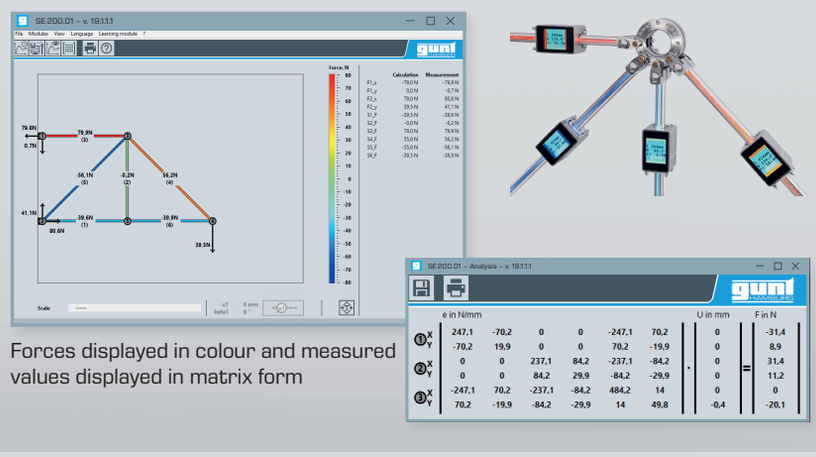


Ritter's method of sections: freeing the bar forces at nodes 3 and 4



Method of joints: freeing the bar forces at node 3

4 Checking the calculation: comparison of results with measured values and results in the GUNT software



Forces displayed in colour and measured values displayed in matrix form

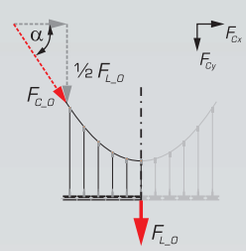
SE 200.02 MEC – Forces on a suspension bridge

Exercises

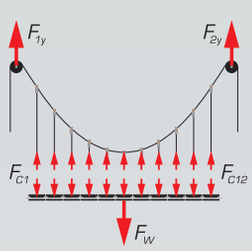
1 Setup of a suspension bridge with rigid roadway and no additional loading

- exact recording of the geometry with real-time transmission to the GUNT software
- measured values displayed directly on the supports, can be hidden if required

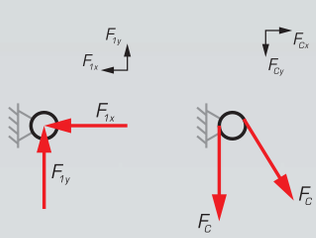
2 Calculation of external and internal forces without additional loading



Simplified sketch of the suspension bridge



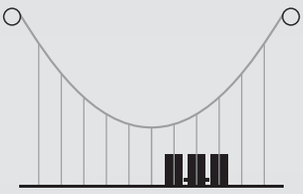
Freeing the internal forces on the suspension bridge



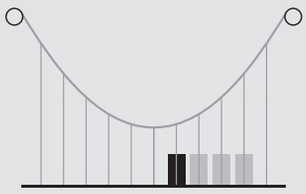
Freeing the support forces and cable forces

3 Calculation of external and internal forces with additional loading by single load, line load or moving load

Loading with single load

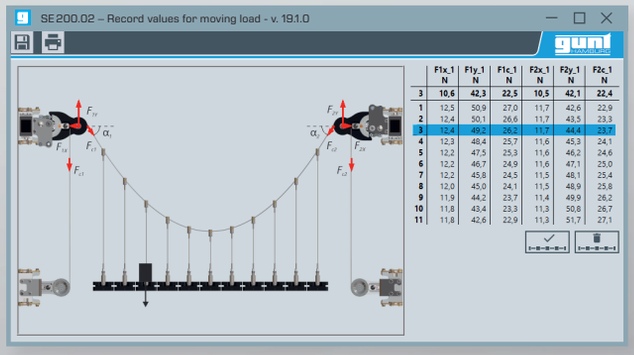


Loading with line load

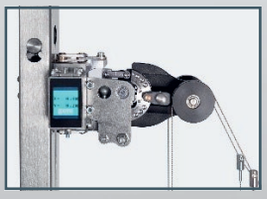


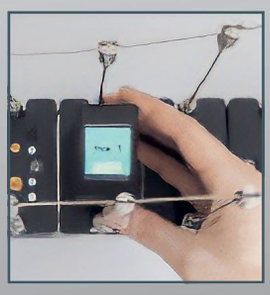
Loading with moving load

4 Checking the calculation: comparison of results with measured values at load/supports and the results from the GUNT software



Recording the measured values when loading with moving load





- setup of a suspension bridge together with smart, communication-enabled accessories
- experiments with rigid or flexible roadway
- automatic identification and assignment of the loads in the GUNT software

Learning objectives

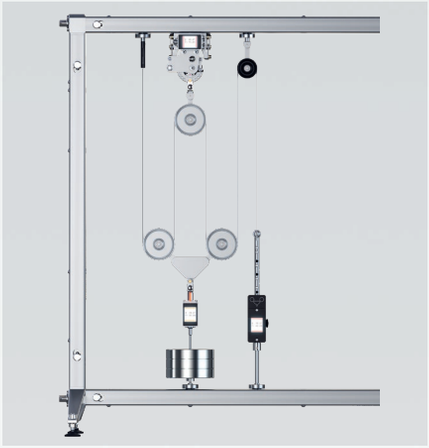
- measurement of suspension cables forces on
  - unloaded suspension bridge
  - loaded suspension bridge
- measurement of the support forces as a function of the loading on the suspension bridge
- behaviour of a suspension bridge with rigid or flexible roadway
- investigation of line loads
- effect of a moving load

SE 200.05 MEC – Cable forces and pulley blocks

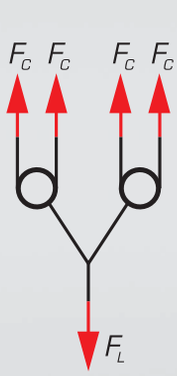
Exercises

1 Setup of a four-cable pulley block with at least one loose and one fixed pulley

- exact recording of the geometry with real-time transmission to the GUNT software
- measured values displayed directly on the suspension cables, can be hidden if required



2 Calculation of cable forces and support forces



Equilibrium of forces:

$$\sum F_y = 0 = 4 \cdot F_C - F_L$$

Cable force:

$$F_C = \frac{F_l}{4}$$

Setting the equilibrium condition and calculation of cable force

Freeing the load to determine the cable forces

Equilibrium of forces:

$$\sum F_y = 0 = F_B - 2 \cdot F_C$$

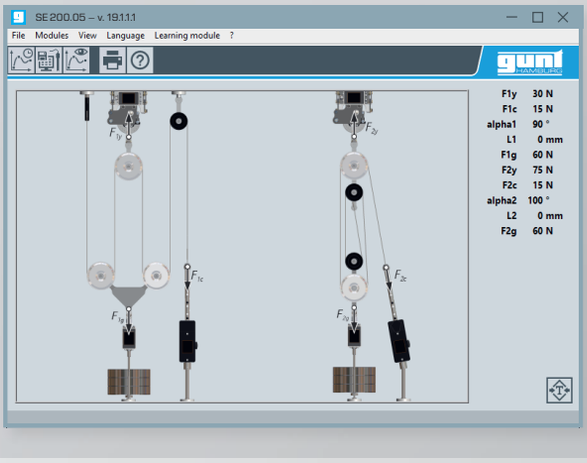
Support force:

$$F_B = \frac{F_C}{2}$$

Setting the equilibrium condition and calculation of support force

Freeing the support forces

3 Checking the calculation: comparison of results with the measured values on suspension cable/supports and the results from the GUNT software



- smart, communication-enabled suspension cables with electronic modules for data acquisition and measured value display
- investigate 2 different pulley blocks at the same time
- 2 setup variants possible per pulley block
- automatic identification and assignment of the pulley blocks in the GUNT software

Learning objectives

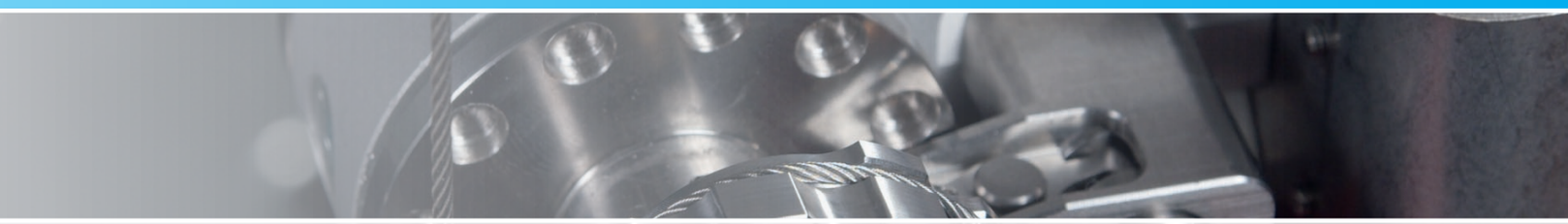
- familiarisation with different pulley blocks
- measurement of
  - cable forces
  - support forces
- angular dependence of forces
- force measurement under different loads

GUNT Science Media Center

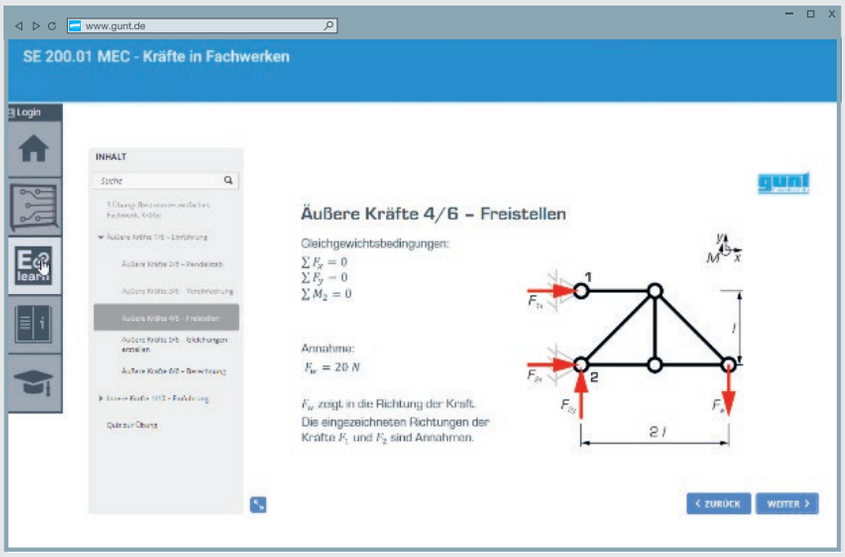
SCIENCE

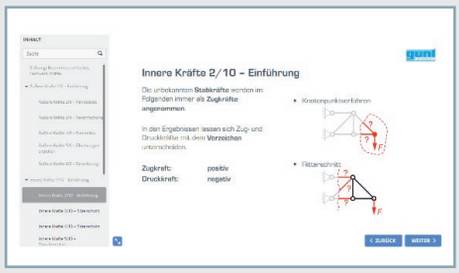
The GUNT Science Media Center provides extensive multimedia teaching material for all experiments.

Customers can access files and product information for selected products at any time and from any place. In addition to digital worksheets and the manual, access to E-Learning is also included.

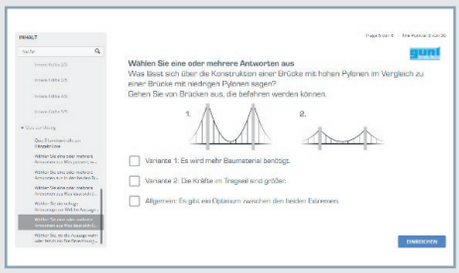


The E-Learning course



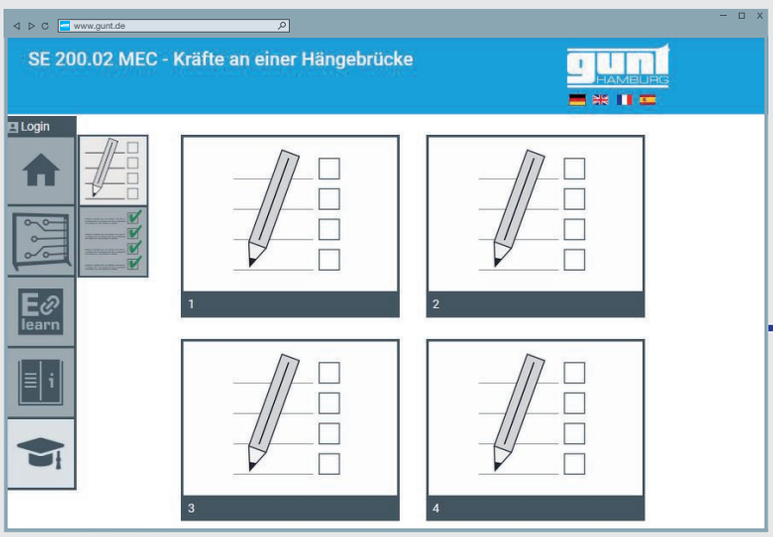


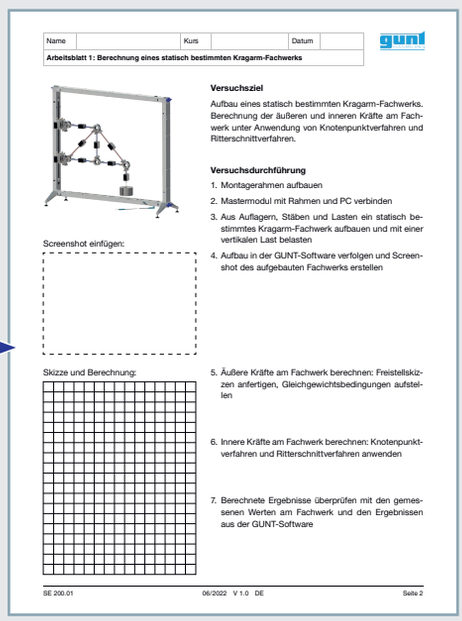
The E-Learning course presents fundamental knowledge and the experiment procedure in detail with engaging animations. Knowledge tests facilitate understanding.



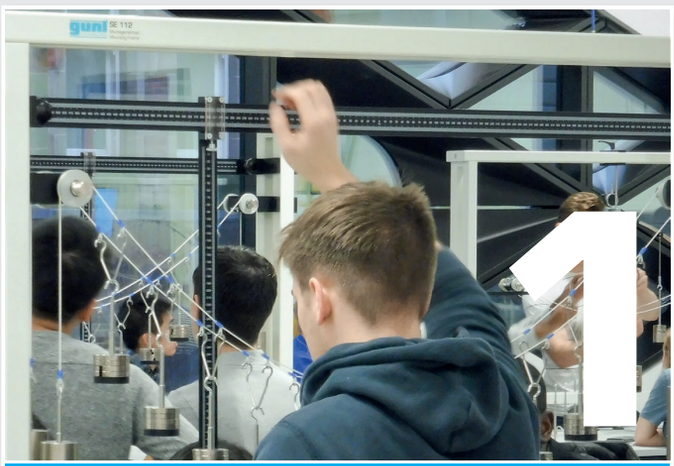
Digital worksheets

Digital worksheets are available for the individual experiments.
Access to solutions is password protected.





Our product programme



Engineering mechanics and engineering design

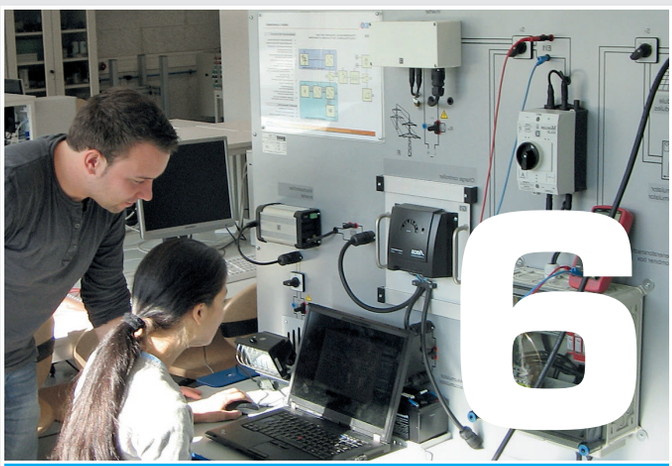
Mechatronics

Fluid mechanics

Process engineering

3 Thermal engineering

New catalogue
Entire programme



6 Energy & Environment

- planning and consulting
- technical service
- commissioning and training

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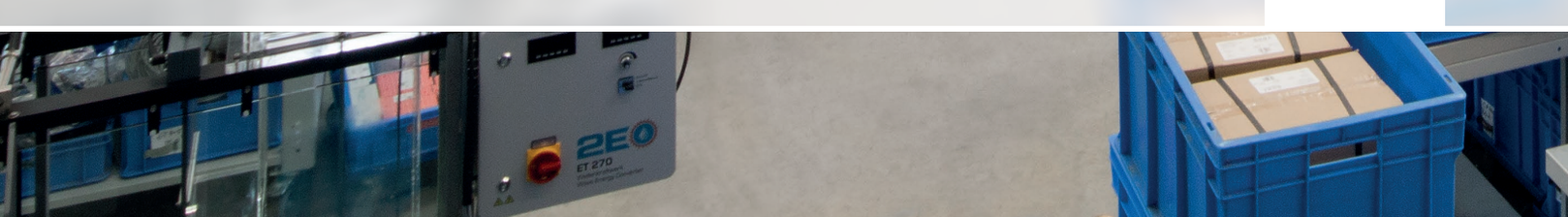
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