

IMPETUS™ & VALIMAT™ – dynamische Materialcharakterisierung leicht gemacht

T. Schaffranek, H. Schmid, P. Reithofer

Technologietag 2019

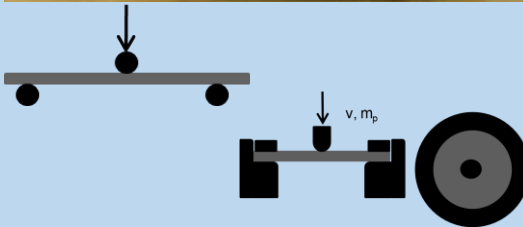
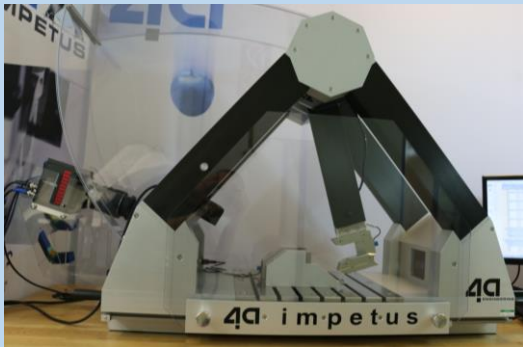
Schladming, 26.02.2019

Content

- IMPETUS™ - dynamic tensile test
- VALIMAT™ - handling test data
- VALIMAT™ - composites

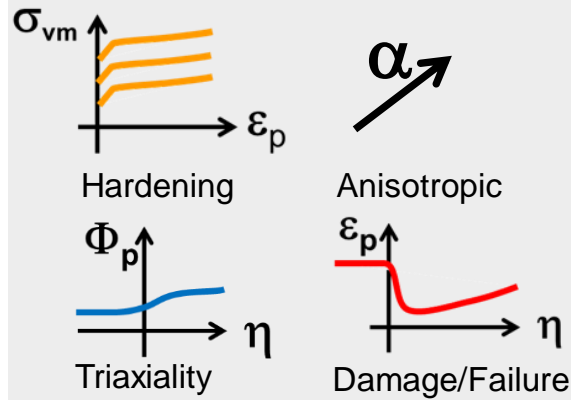
intelligent reliable solutions for plastics, composites, metals, foams, ...

IMPETUS



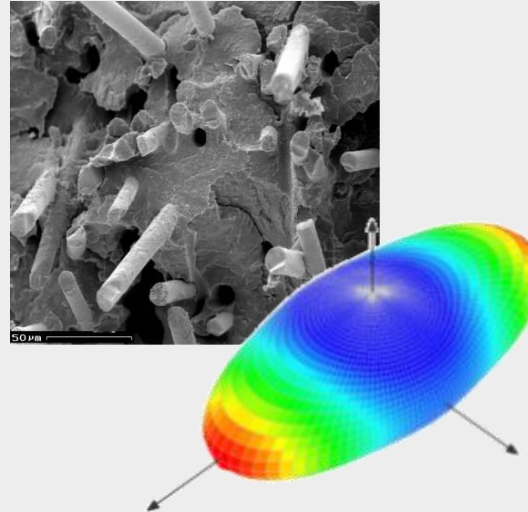
efficient
dynamic testing

VALIMAT



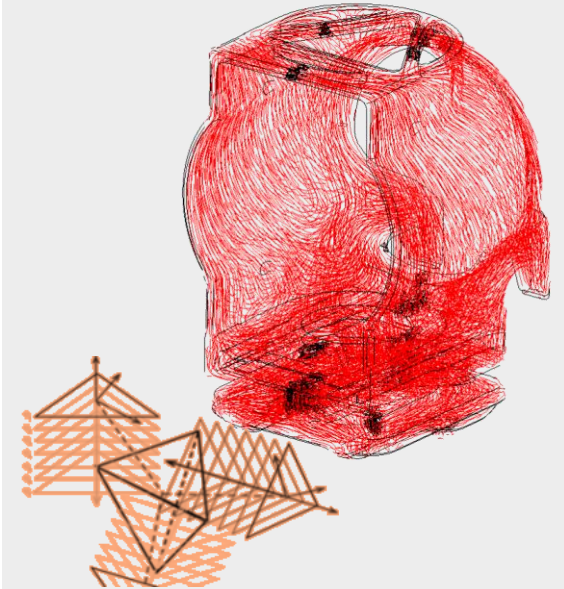
from test to validated
material cards

MICROMECH



3D anisotropic
material cards

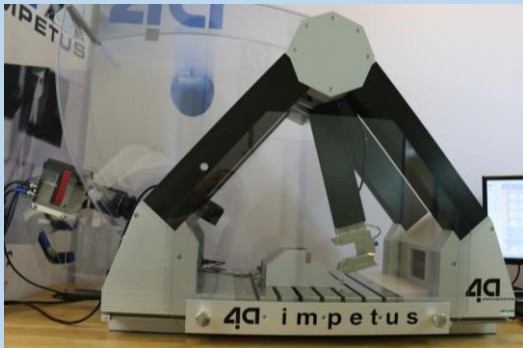
FIBERMAP



individual mapping
process information

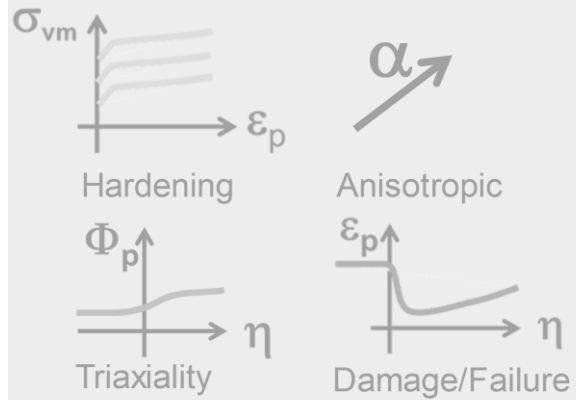
intelligent reliable solutions for plastics, composites, metals, foams, ...

 **IMPETUS**



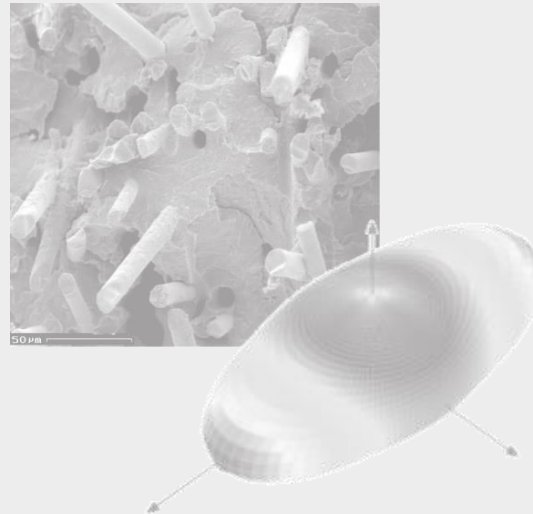
efficient
dynamic testing

 **VALIMAT**



from test to validated
material cards

 **MICROMECH**



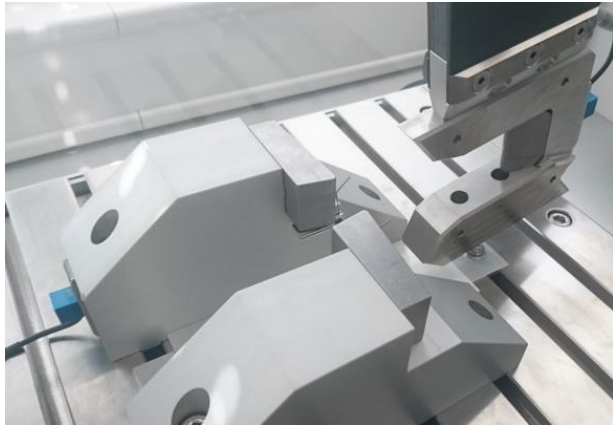
3D anisotropic
material cards

 **FIBERMAP**



individual mapping
process information

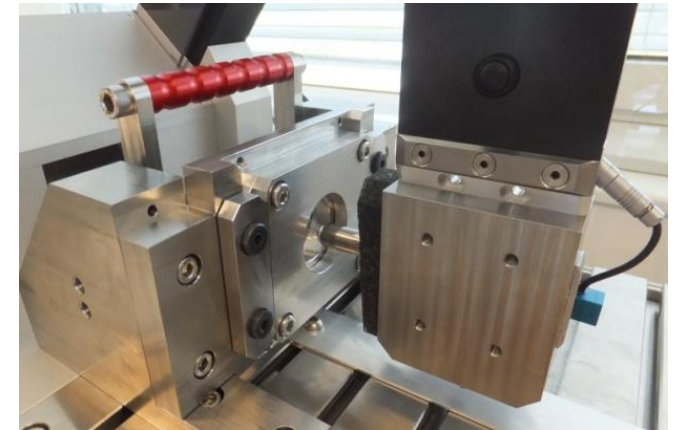
IMPETUS™ - test setup



bending test



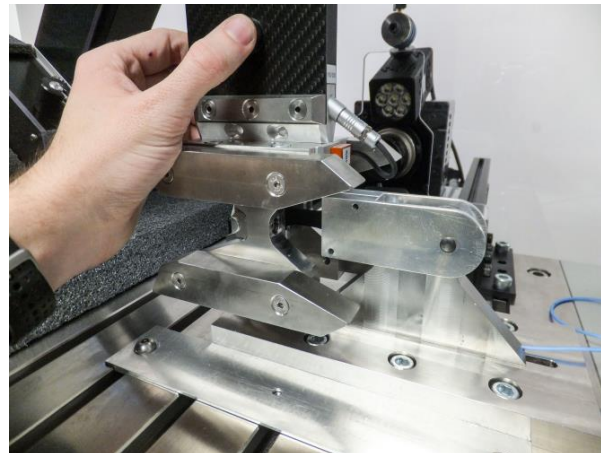
tension bending test



puncture test



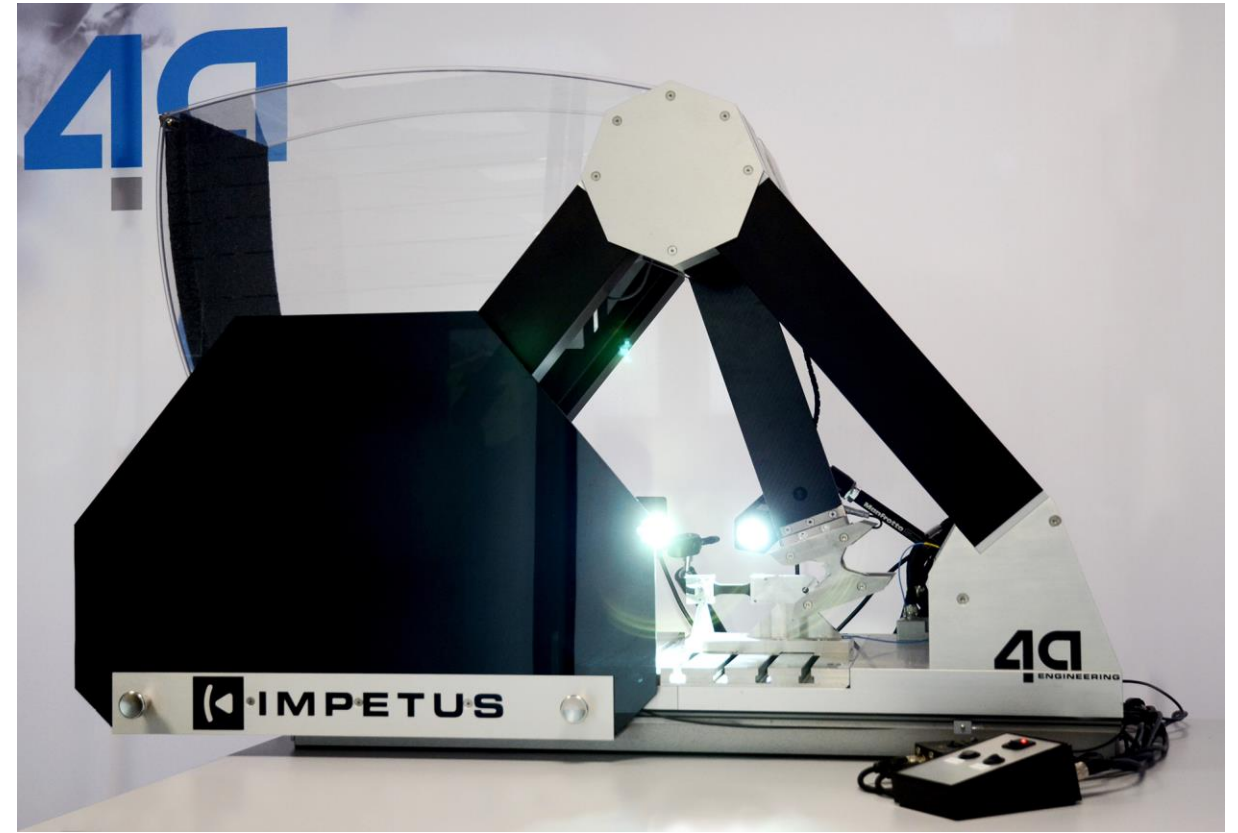
compression test



new tensile test

IMPETUS™ - dynamic tensile test

- Compatible with IMPETUS™ Gen. 4 & 5
- Parts of the dynamic tensile test (basic kit)
 - Test setup
 - Piezo load cell
 - Pendulum Head
 - Sample holder
 - Mounting kit for sample holder

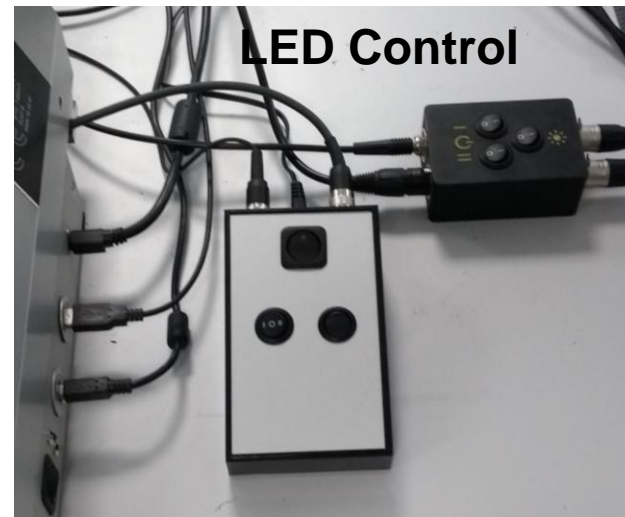
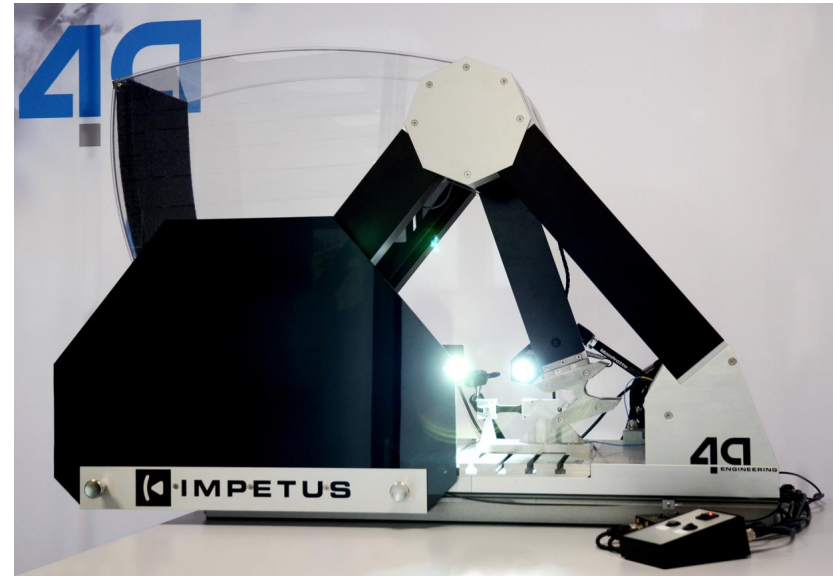


IMPETUS™ - dynamic tensile test

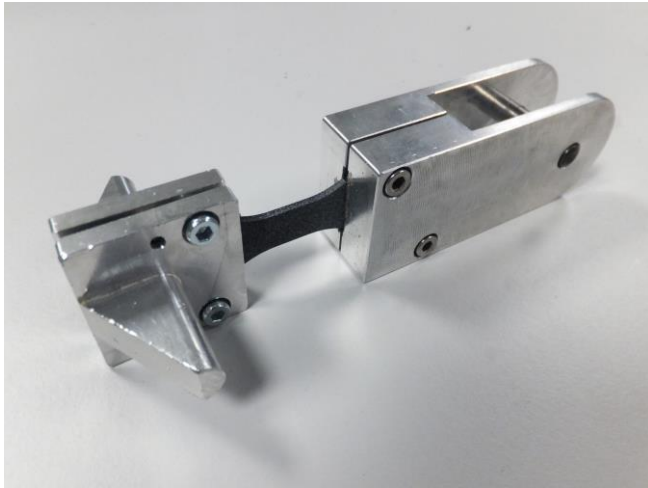
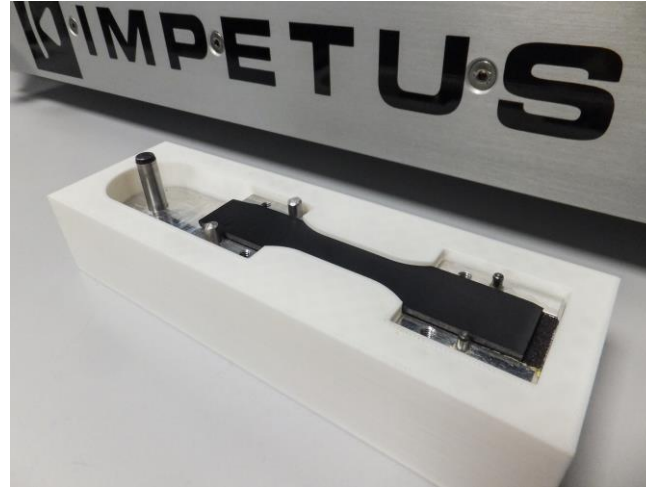
- Compatible with IMPETUS™ Gen. 4 & 5
- Parts of the dynamic tensile test (extension kit)
 - LED-Lights
 - Mount for highspeed camera
 - Tinted security window
 - Highspeed camera

Photron

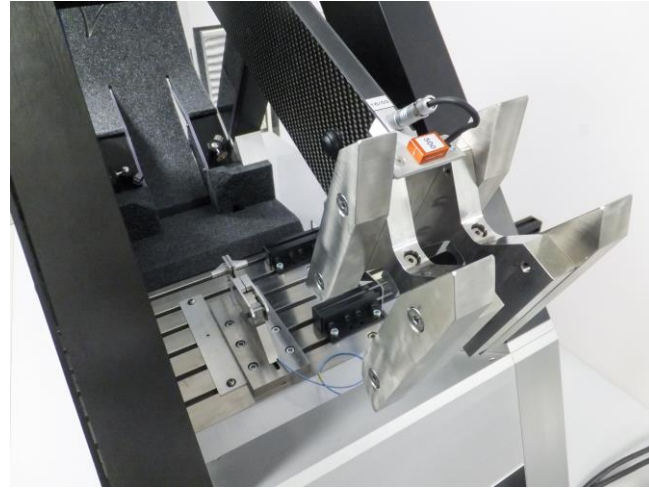
VKT
Video Kommunikation GmbH
Technisches Fernsehen



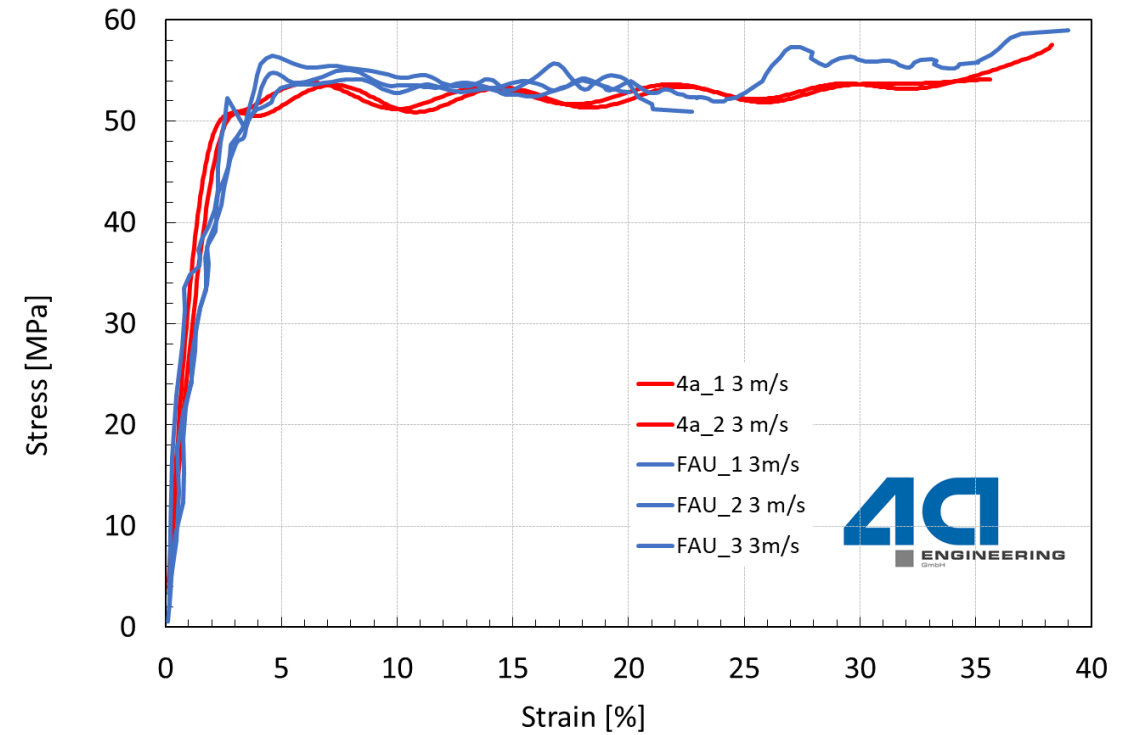
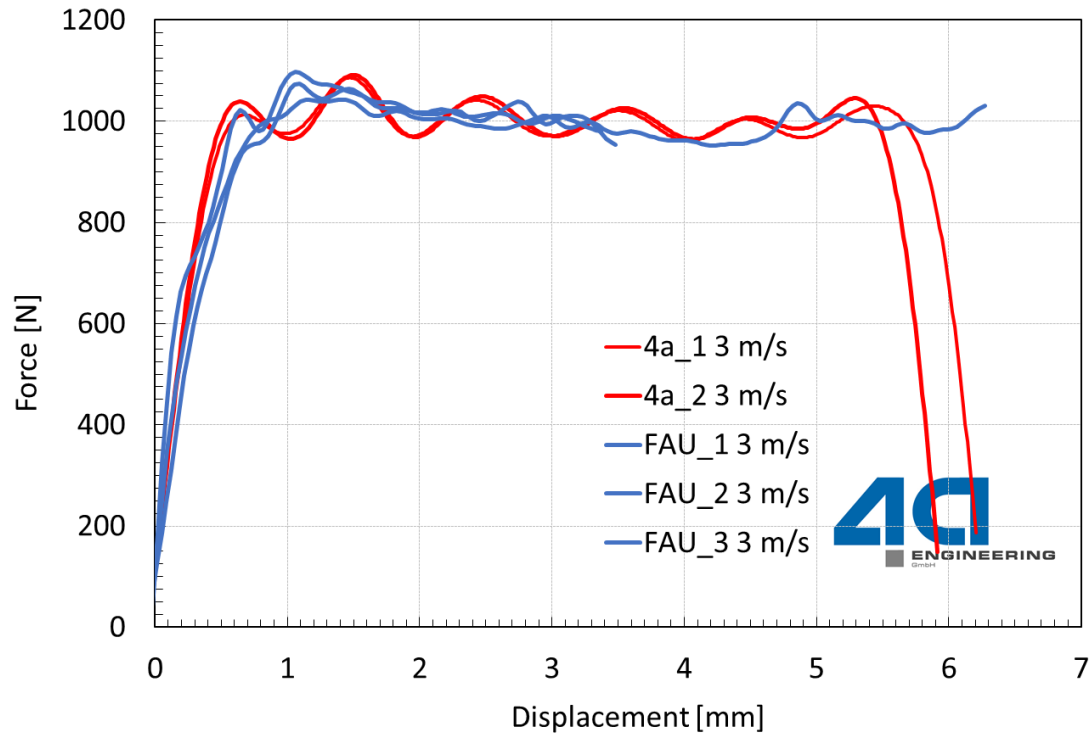
IMPETUS™ - dynamic tensile test



IMPETUS™ - dynamic tensile test

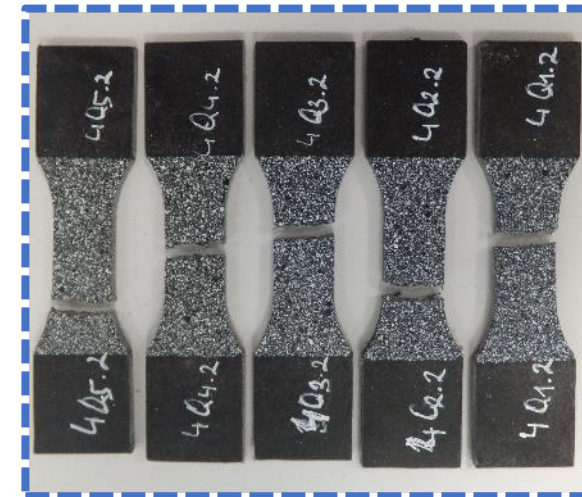
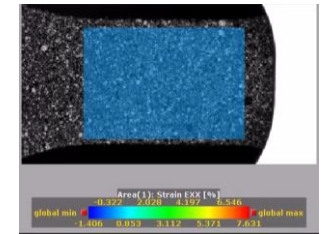
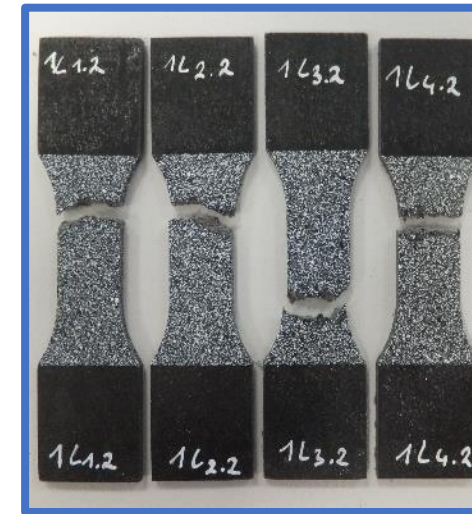
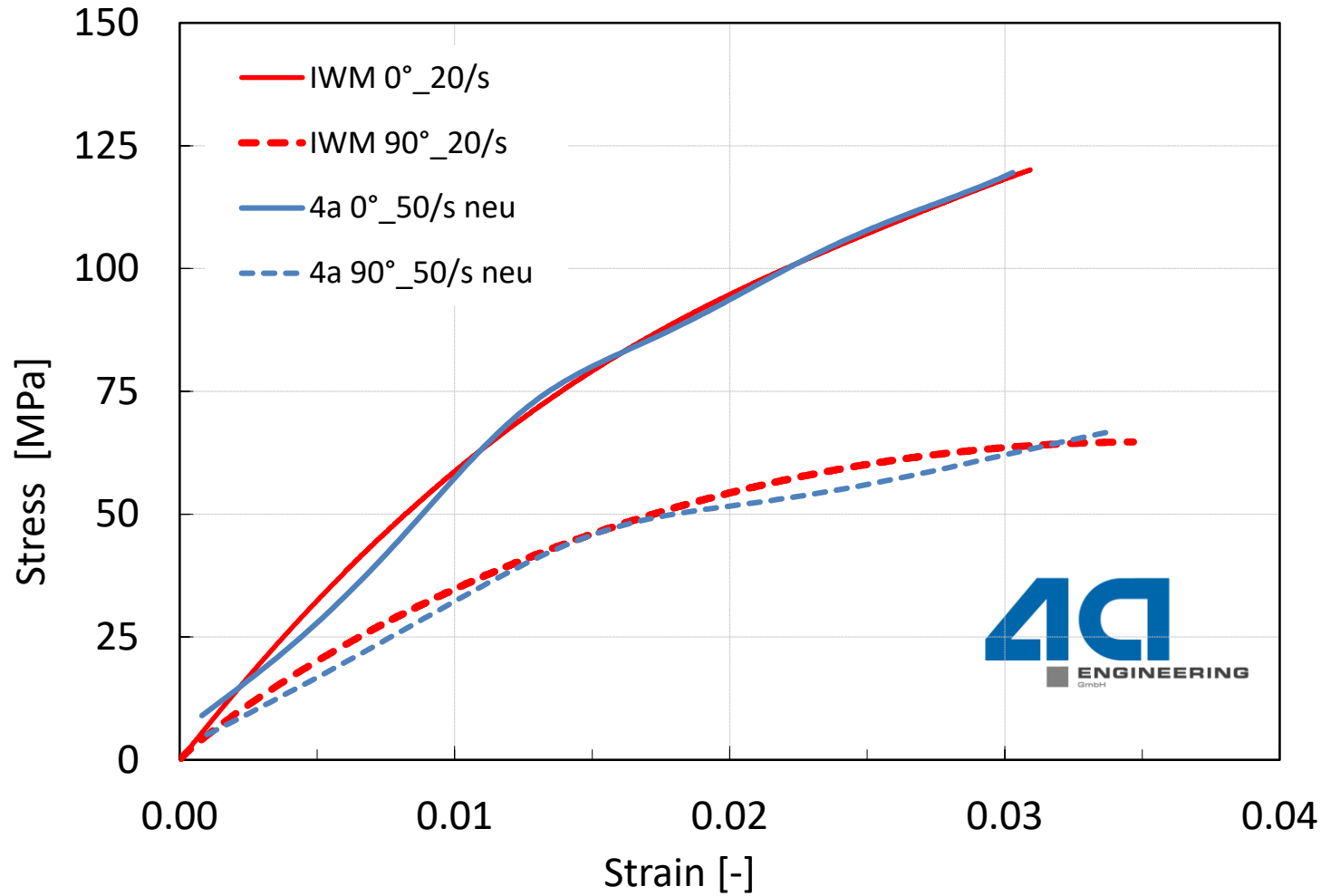


IMPETUS™ - dynamic tensile test comparison 4a / FAU POM



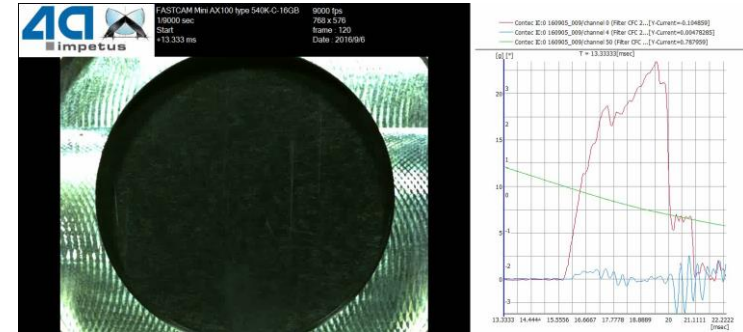
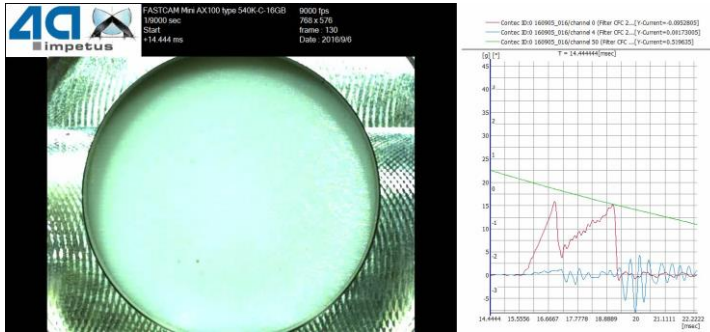
IMPETUS™ - dynamic tensile test

comparison 4a / IWM PP-LGF 30

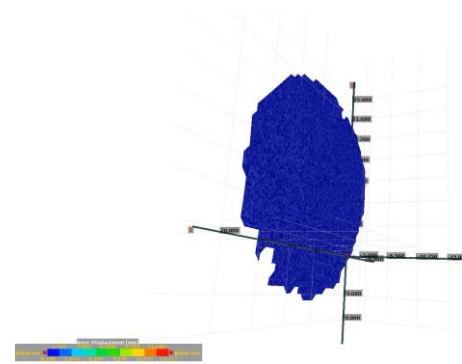
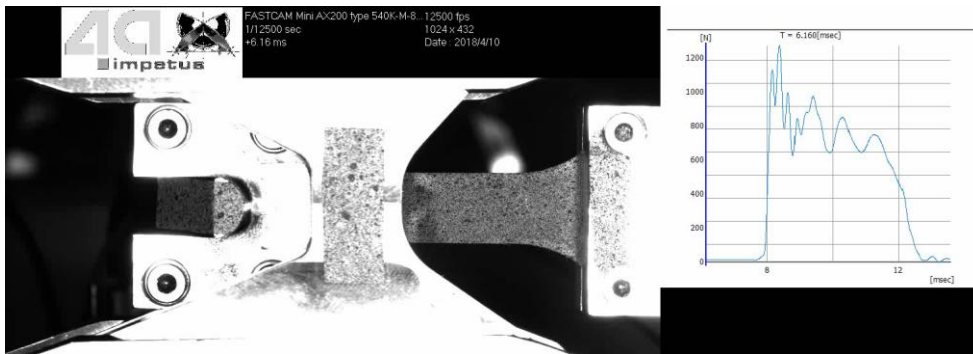


IMPETUS™ - dynamic tensile test

- Highspeed camera
 - Information about crack propagation

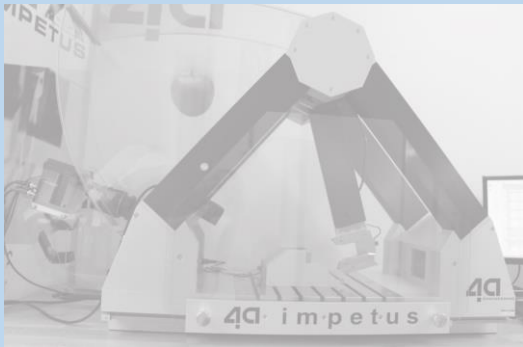


- Strain measurement with digital image correlation (DIC)



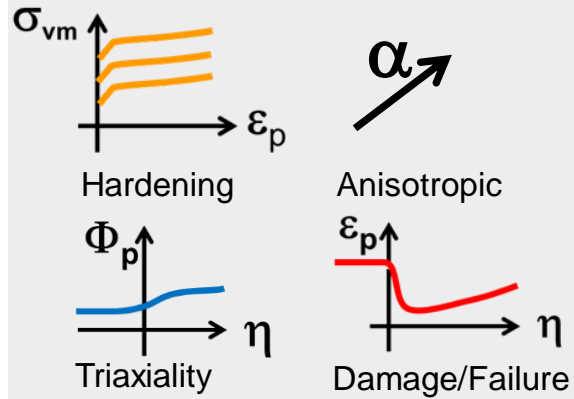
intelligent reliable solutions for plastics, composites, metals, foams, ...

 **IMPETUS**



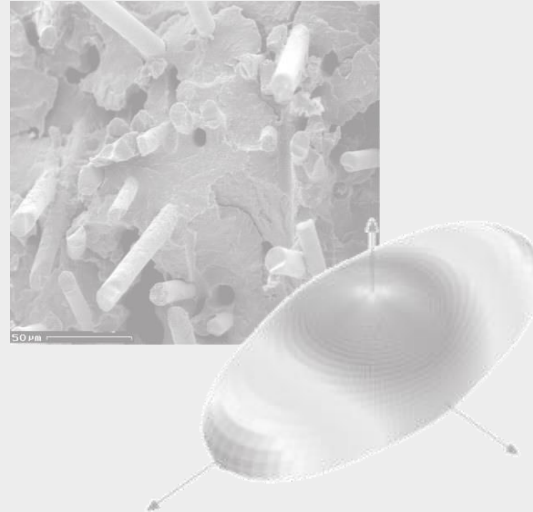
efficient
dynamic testing

 **VALIMAT**



from test to validated
material cards

 **MICROMECH**



3D anisotropic
material cards

 **FIBERMAP**



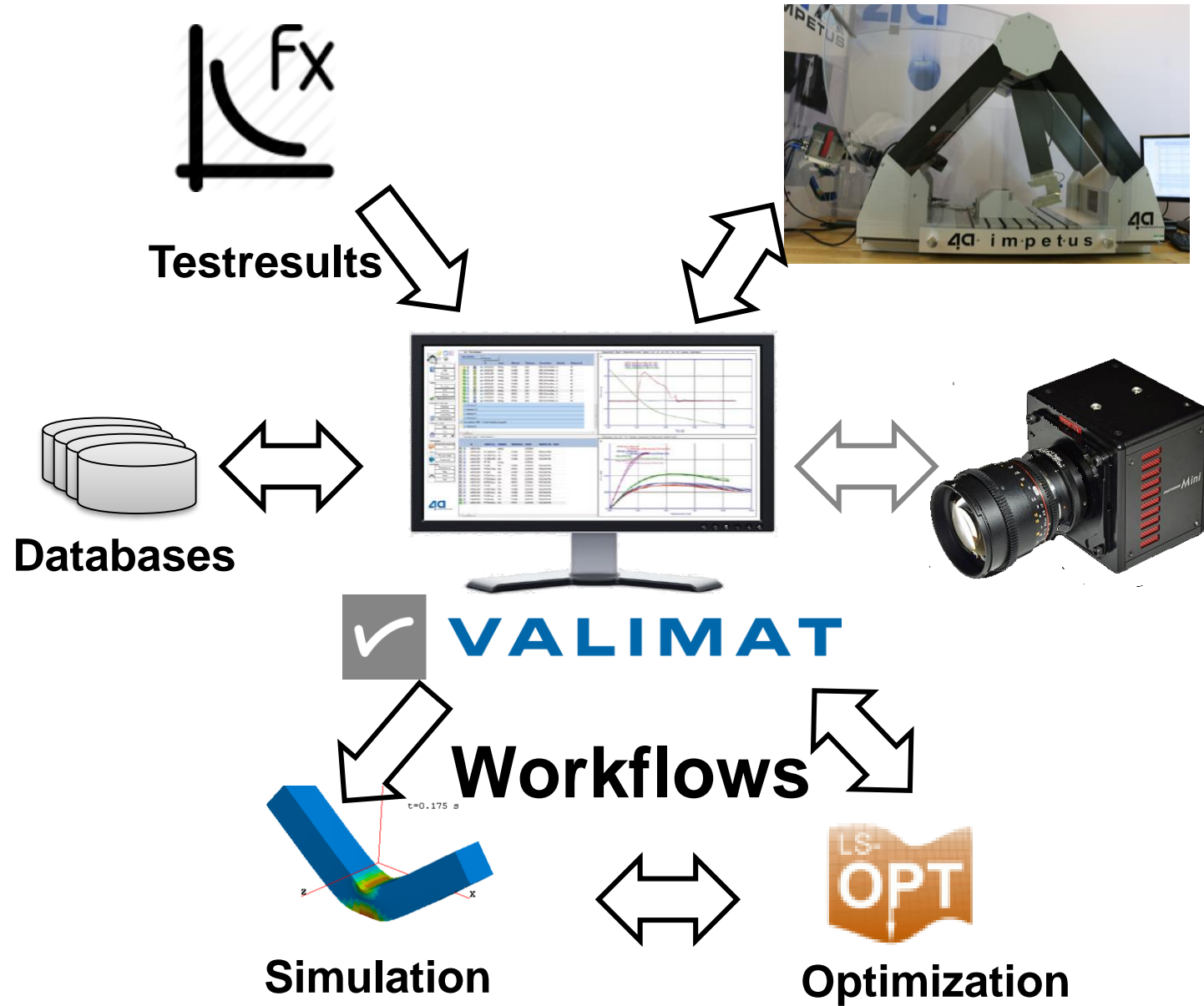
individual mapping
process information

from test to material card

VALIMAT™

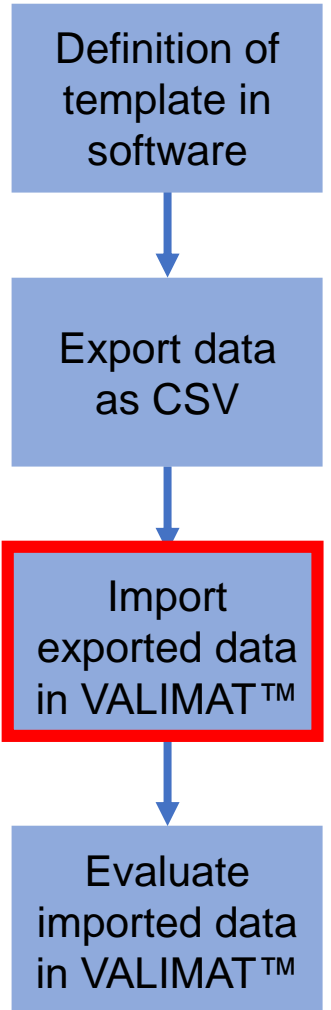
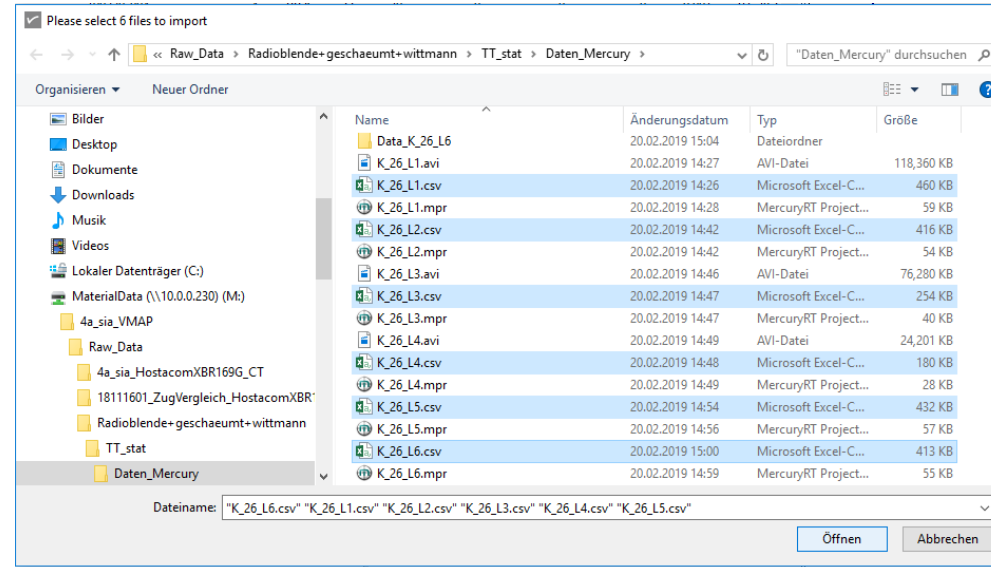
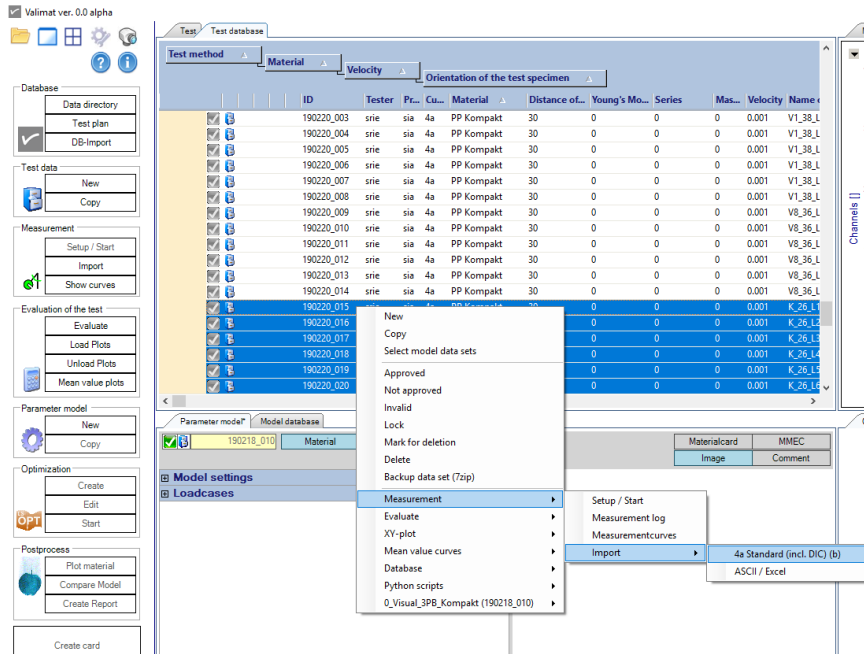
Advantage

- Handling of bigdata
- Complex models
- Good correlation to simulation



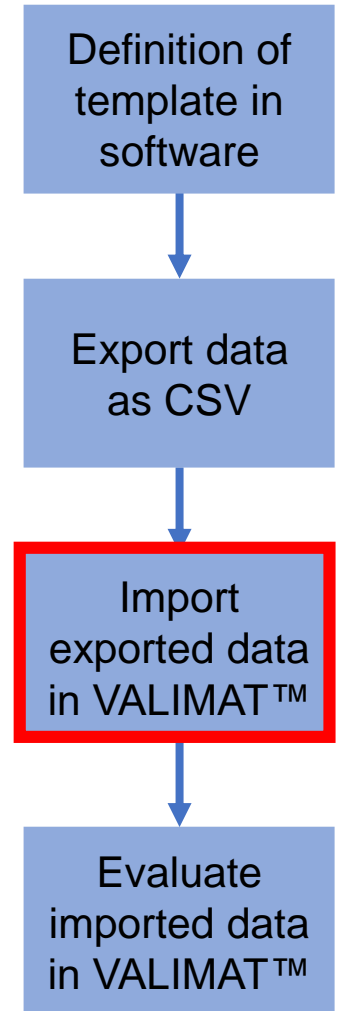
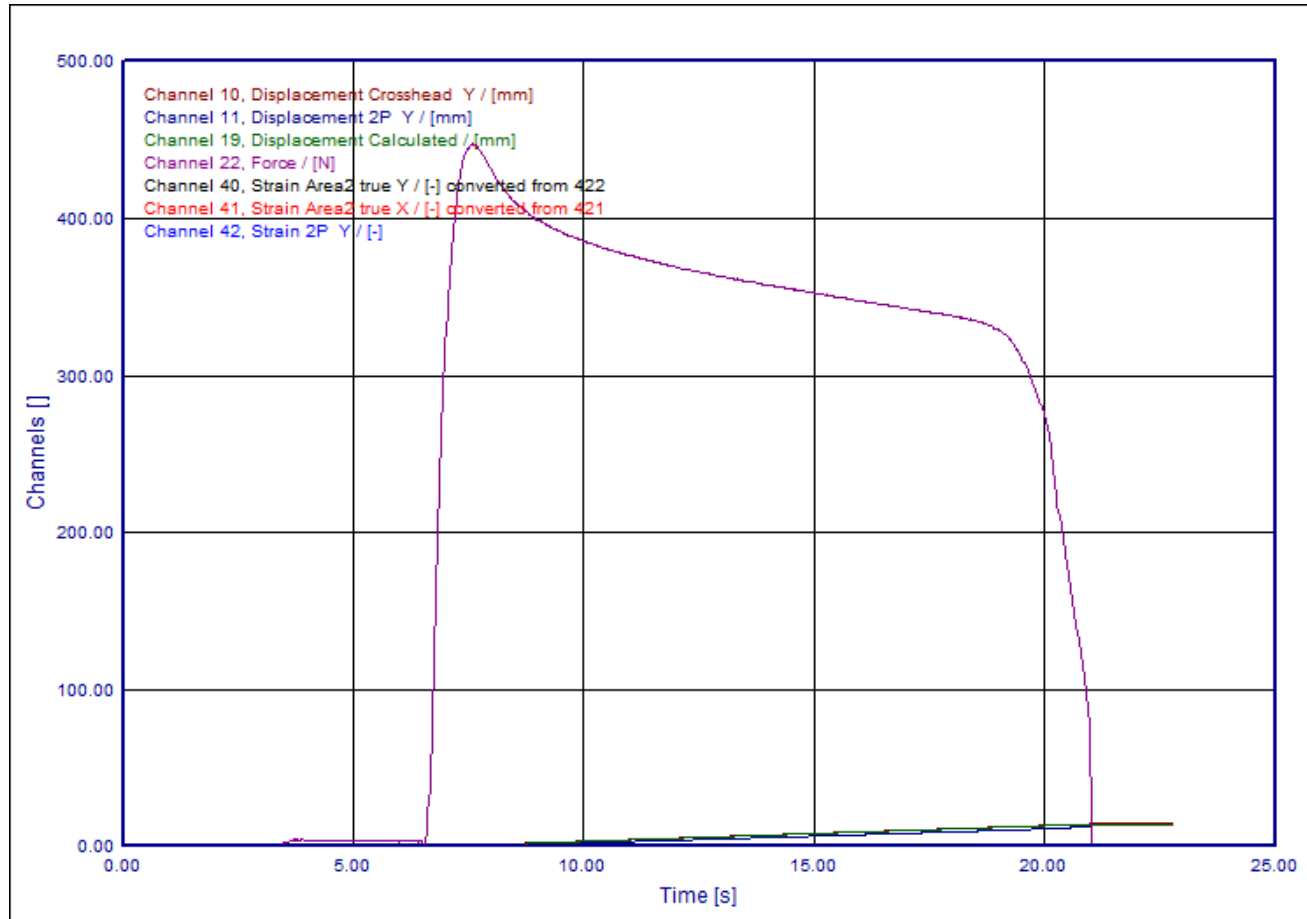
VALIMAT™ - handling test data - example tensile test

- Import of digital image correlation test data with 4a standard template



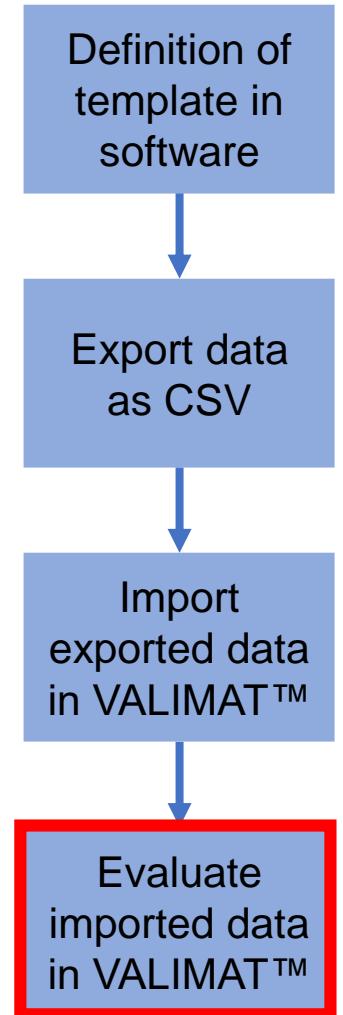
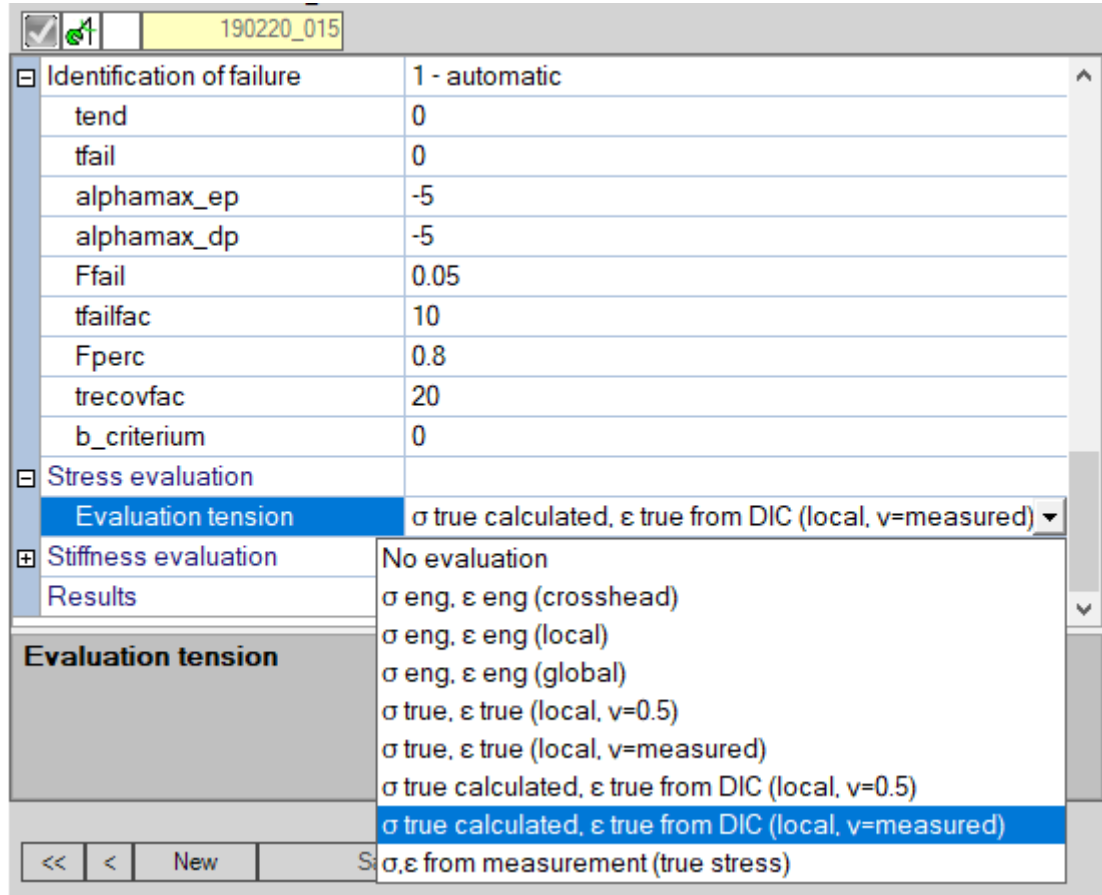
VALIMAT™ - handling test data - example tensile test

- Import of digital image correlation test data with 4a standard template



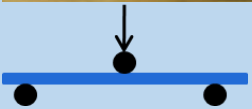
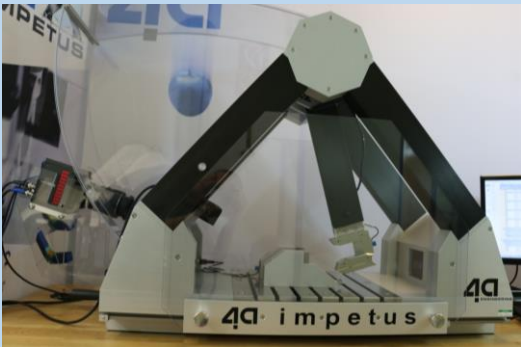
VALIMAT™ - handling test data - example tensile test

- Import of digital image correlation test data with 4a standard template

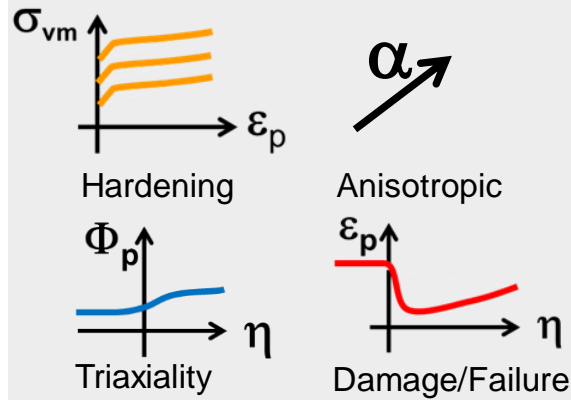


intelligent reliable solutions for plastics, composites, metals, foams, ...

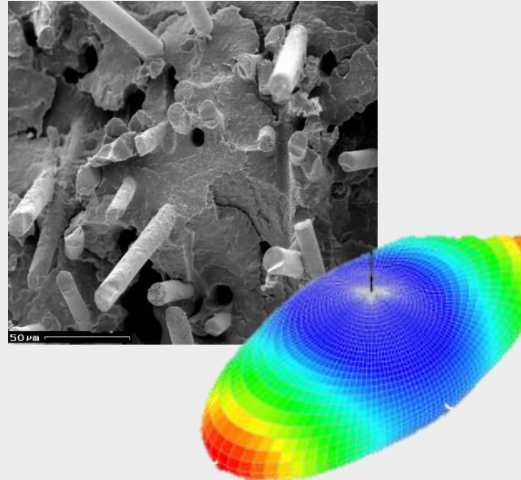
IMPETUS



VALIMAT



MICROMECH



FIBERMAP



Composites (Carbon)

efficient
dynamic testing

from test to validated
material cards

3D anisotropic
material cards

individual mapping
process information



Database

- Data directory
- Test plan
- DB-Import

Test data

- New
- Copy

Measurement

- Setup / Start
- Import
- Show curves

Evaluation of the test

- Evaluate
- Load Plots
- Unload Plots
- Mean value plots

Parameter model

- New
- Copy

Optimization

- Create
- Edit
- Start

Postprocess

- Plot material
- Compare Model
- Create Report

Create card

Test database

Test method: Velocity

Orientation of the test specimen: 90

Temperature of the test specimen: 0

ID	Tester	Project name	Customer	Material	Name of th...	Series	Thickness	W
180615_011	kgir			GFK	G_Q1_1	Vergleich	2.108	15.0
180615_012	kgir			GFK	G_Q1_2	Vergleich	2.108	15.0
180615_013	kgir			GFK	G_Q1_3	Vergleich	2.108	15.0

Temperature of the test specimen: 23

180528_089	4aeng	ski	MCT	GFK	G_Q2	UD	2.1	15.0
180528_103	4aeng	ski	MCT	GFK	G_Q5	UD	2.107	15.0
180528_126	4aeng	ski	MCT	GFK	G_Q8	UD	2.103	15.0
180528_127	4aeng	ski	MCT	GFK	G_Q11	UD	2.103	15.0
180528_128	4aeng	ski	MCT	GFK	G_Q14	UD	2.102	15.0

Velocity: 2.5

Orientation of the test specimen: 0

Temperature of the test specimen: 23

180528_102	srie	ski	MCT	GFK	G_L2	UD	2.108	15.0
180528_106	srie	ski	MCT	GFK	G_L12	MD	1.9	15.0

Parameter model

Model database

180910_012

Material Designvariables Layers

Materialcard MMEC

Image Comment

Element size 2

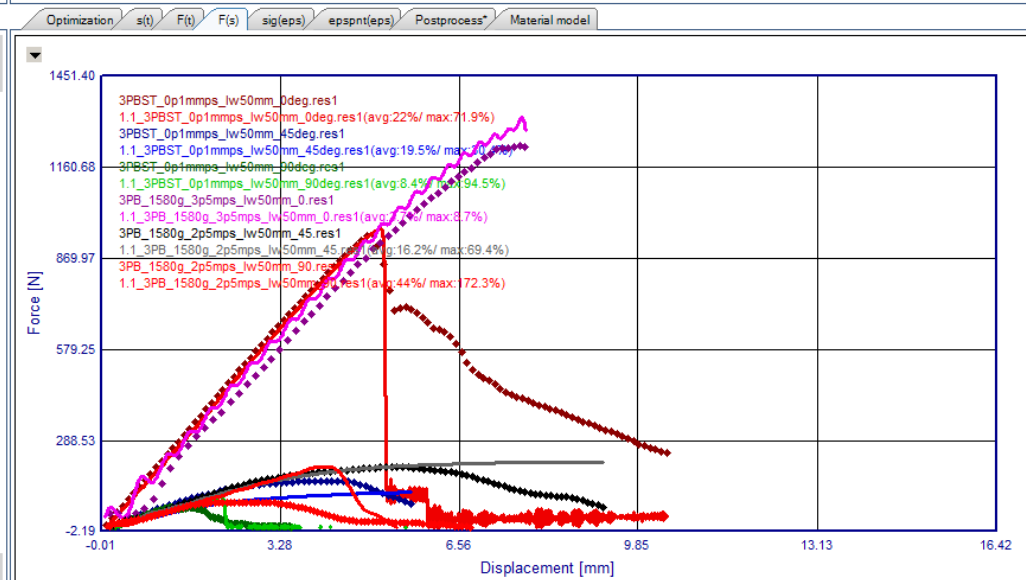
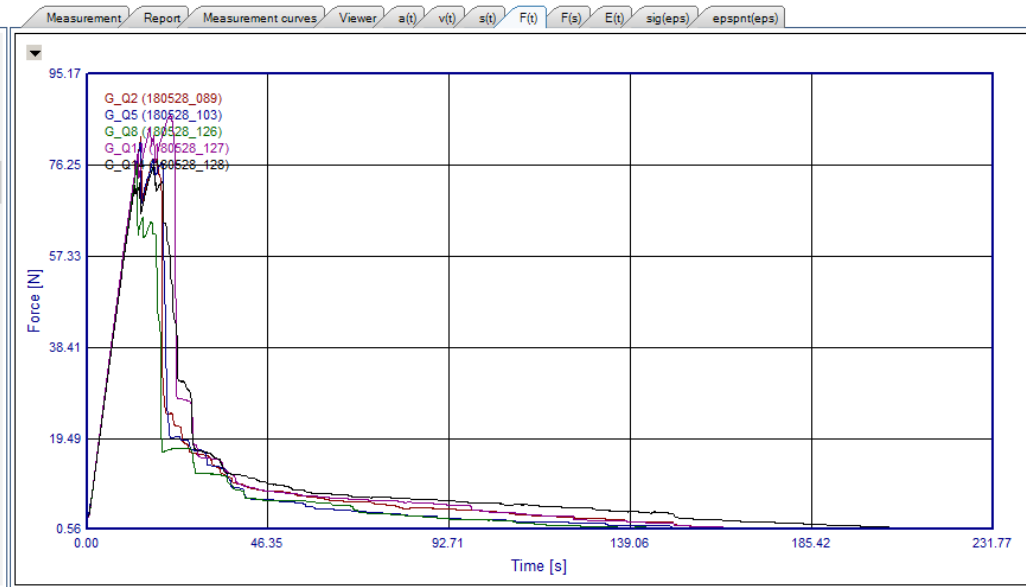
Additional settings

Material behaviour

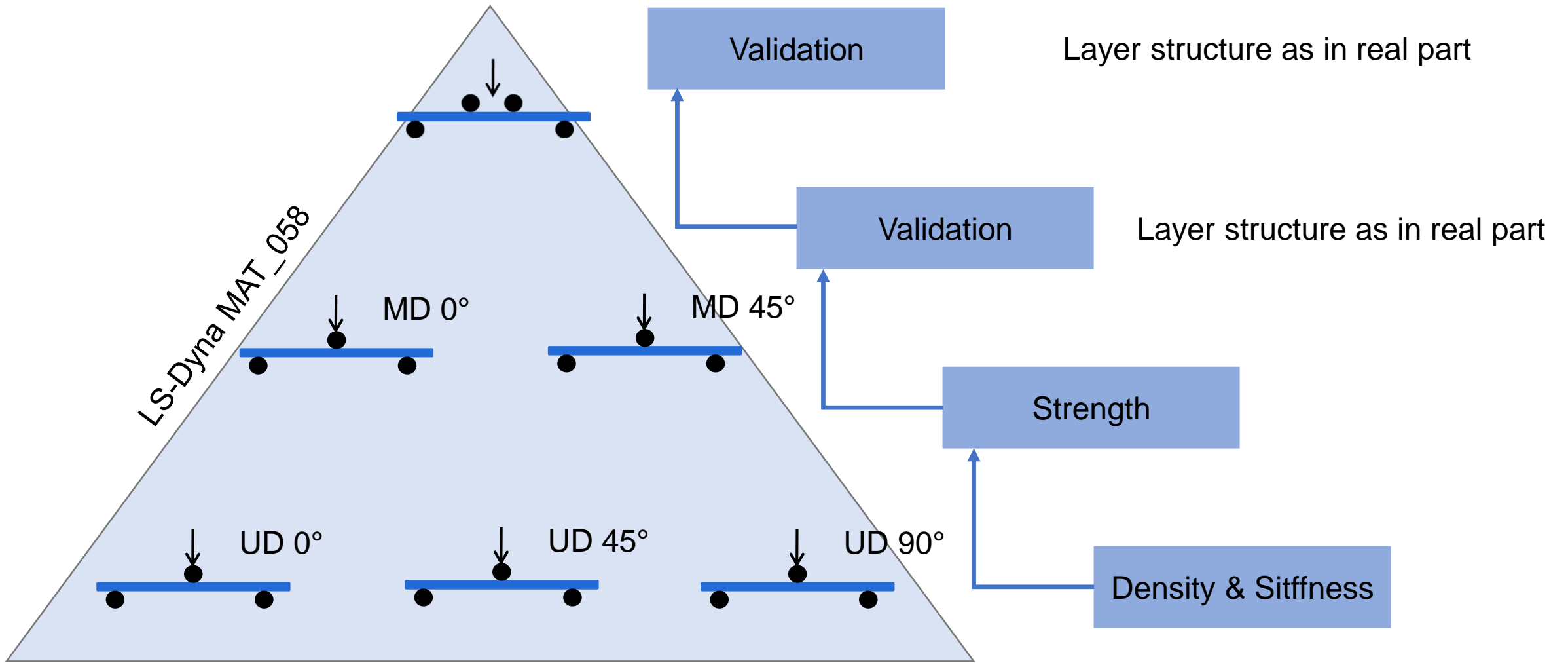
- Material source Implemented
- Elasticity Not isotropic elastic
- Plasticity No
- Failure/Damage Composite

Material card *MAT_LAMINATED_COMPOS

- *MAT_SAMP-1 (*MAT_187)
- *MAT_COMPOSITE_DAMAGE (*MAT_022)
- *MAT_ENHANCED_COMPOSITE_DAMAGE (*MAT_054)
- *MAT_LAMINATED_COMPOSITE_FABRIC (*MAT_058)
- *MAT_RATE_SENSITIVE_COMPOSITE_FABRIC (*MAT_158)
- *MAT_LAMINATED_FRACTURE_DAIMLER_PINHO (*MAT_261)
- *MAT_LAMINATED_FRACTURE_DAIMLER_CAMANHO (*MAT_...)
- *MAT_ANISOTROPIC_ELASTIC_PLASTIC (*MAT_157)
- *MAT_4A_MICROMECC (*MAT_215)
- *MAT_4A_MICROMECC (*MAT_215)+Carbon



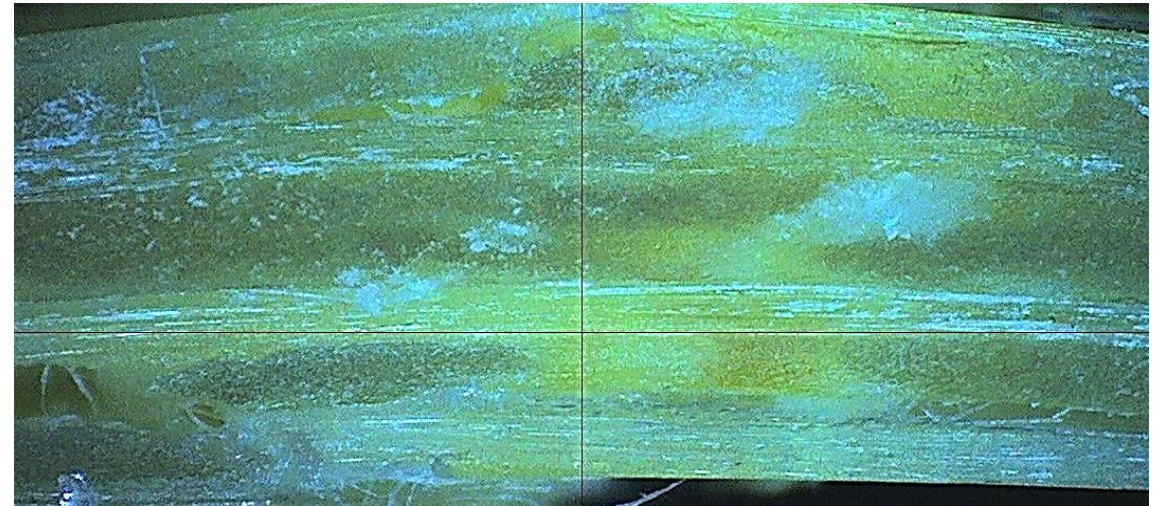
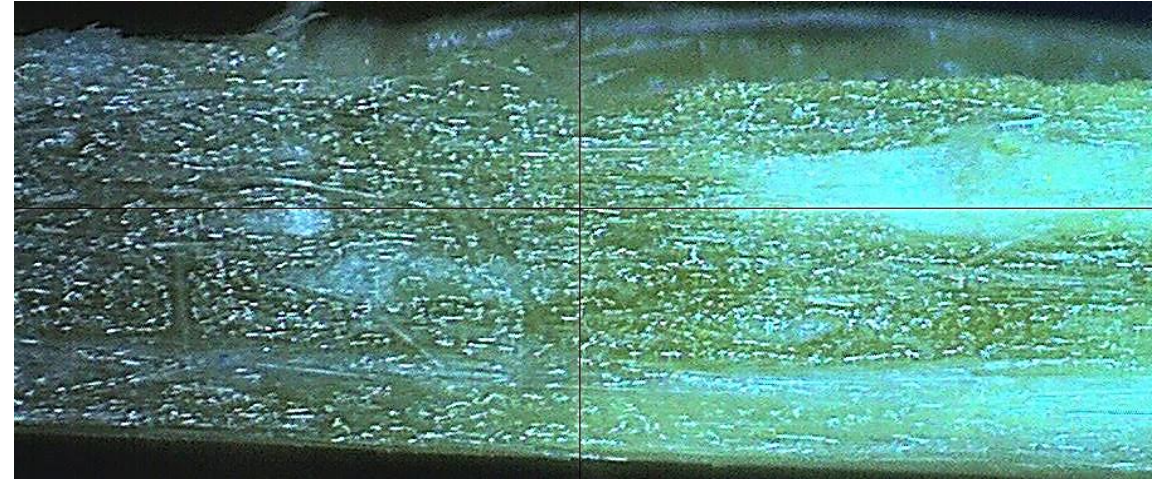
VALIMAT™ - composites



VALIMAT™ - composites - example GFK

- Layer
 - 2 mm UD 9 Lagen 327g/m², FVG 56%

- 1.8 mm MD 8 Lagen 327g/m², FVG 56%
(+45, -45, +45, -45, sym.)

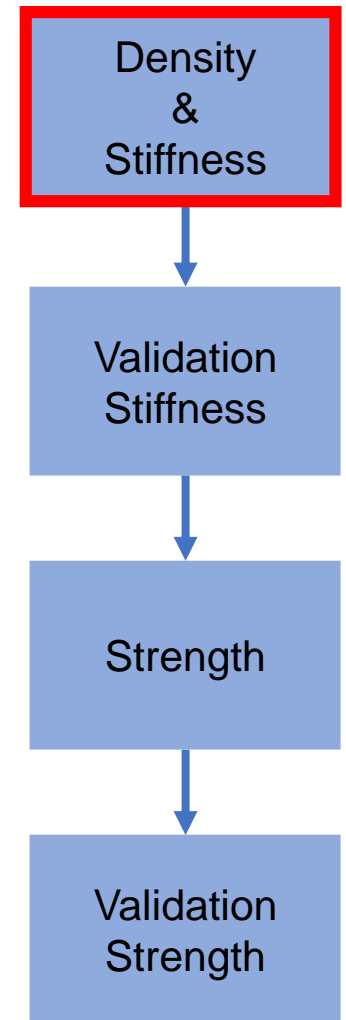


VALIMAT™ - composites - example GFK UD

- Density & Stiffness

Calculation of composite values based on fiber and resin values with VALIMAT™ module MMEC

The screenshot shows the 'Parameter model' window with the 'Material' tab selected. The material name is '180810_027'. The 'Micromec' section is expanded to show 'Endless fiber reinforced plastics'. The 'Matrix' section is expanded to show properties: Density of the matrix (1150), E-Modulus of the matrix (4000), Poisson's ratio of the matrix (0.3), Yield strength of the matrix (50), Strength at break of the mat (85), and Failure strain of the matrix (0.06). The 'Fiber' section is expanded to show properties: Fillerlength (20000), Fillerdiameter (20), Volume (φ) / Masspercent (ψ) (56), Masspercent (ψ) (74.6), and Fillermaterial (E-Glas). The 'Materialcard' section is expanded to show a list of properties: Composite Density (1990 [g/dm³]), c_E11 (40970 [MPa]), c_E22 (11140 [MPa]), c_E33 (11140 [MPa]), c_G12 (4647 [MPa]), c_G23 (4072 [MPa]), c_G31 (4647 [MPa]), c_nue21 (0.06949 [1]), c_nue31 (0.06949 [1]), c_nue32 (0.3674 [1]), fc_R11C (800 [MPa]), fc_R11T (800 [MPa]), fc_R12 (80 [MPa]), fc_R22C (160 [MPa]), and fc_R22T (88 [MPa]).



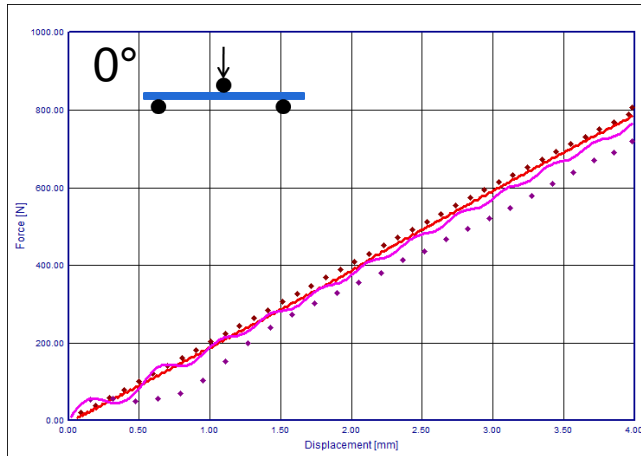
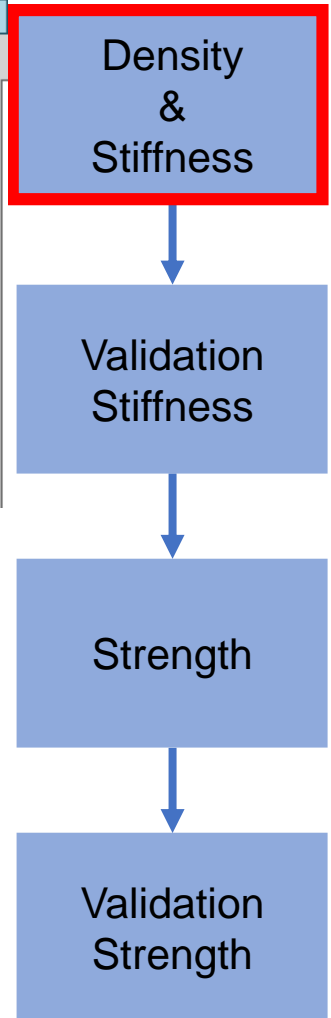
VALIMAT™ - composites - example GFK

- Stiffness on UD 9 layers
 - Definition of layers
 - Simulation of tests with calculated values

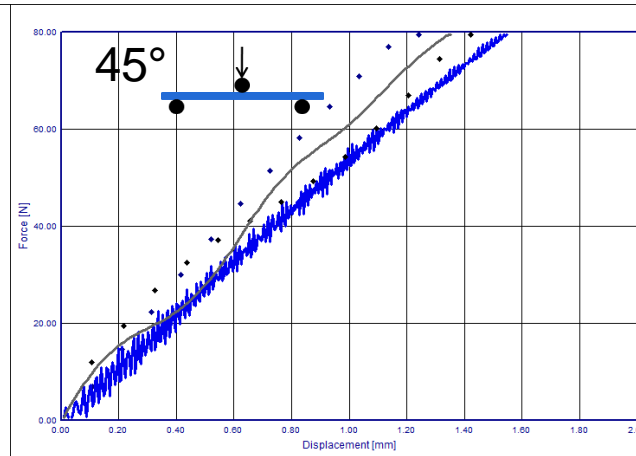
Parameter model* Model database

180810_029 Material Designvariables Layers

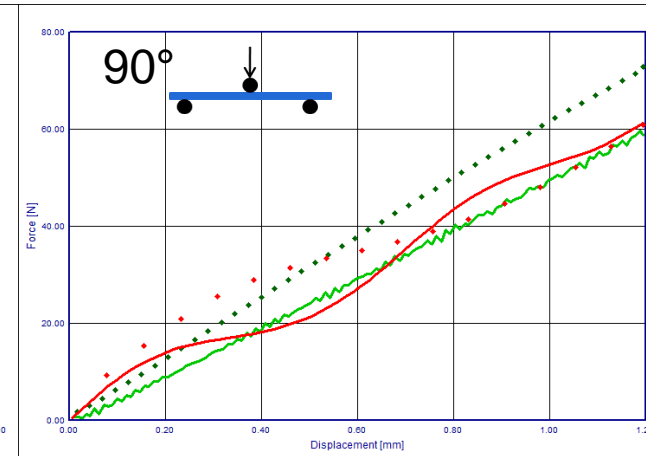
MaterialID	Thickness	angle
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0



0.1 mm/s 3.5 m/s



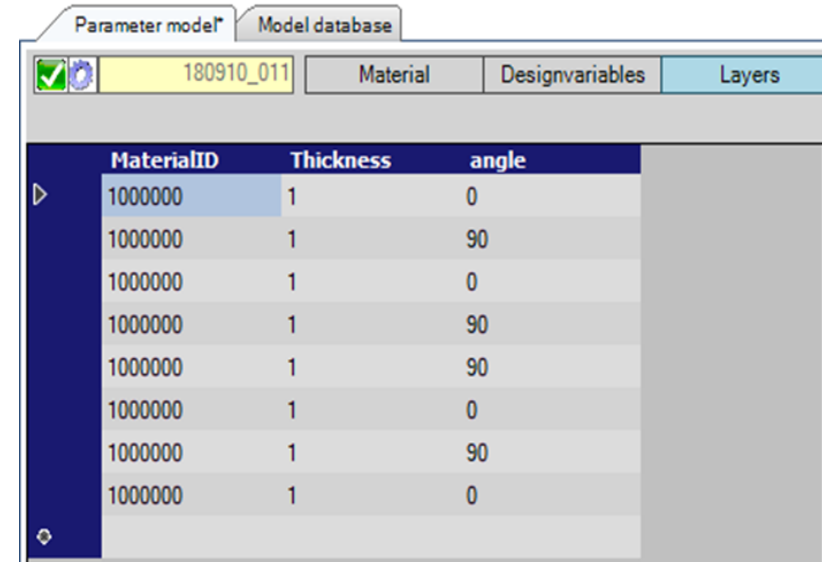
0.1 mm/s 2.5 m/s



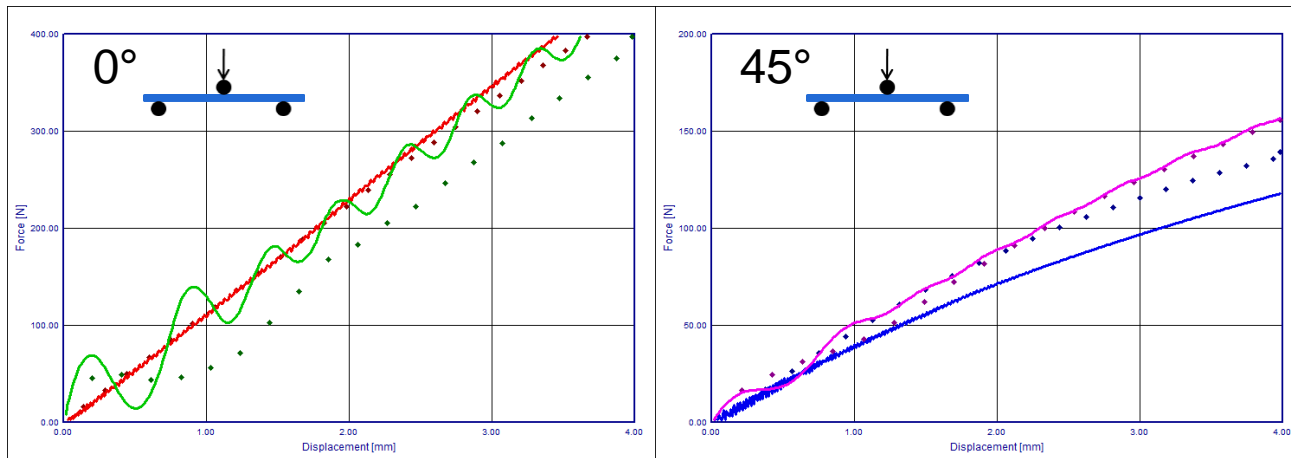
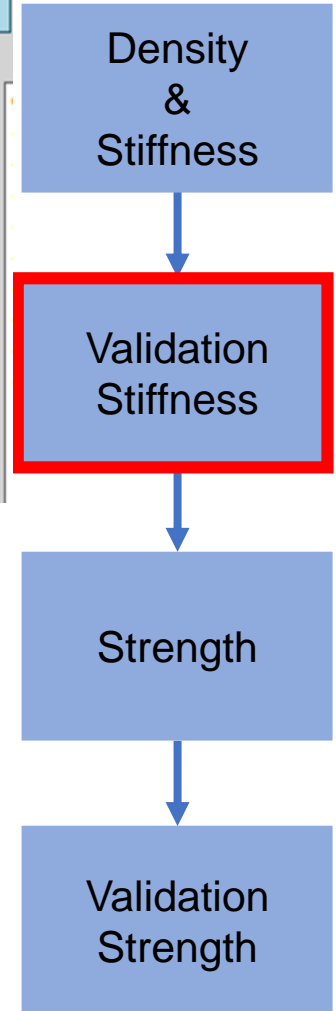
0.1 mm/s 2.5 m/s

VALIMAT™ - composites Example GFK

- Validation of Stiffness on MD 8 layers
 - Definition of layers
 - Simulation of tests with the values of UD 9 layers
 - Variation of material properties if necessary



MaterialID	Thickness	angle
1000000	1	0
1000000	1	90
1000000	1	0
1000000	1	90
1000000	1	90
1000000	1	0
1000000	1	90
1000000	1	0



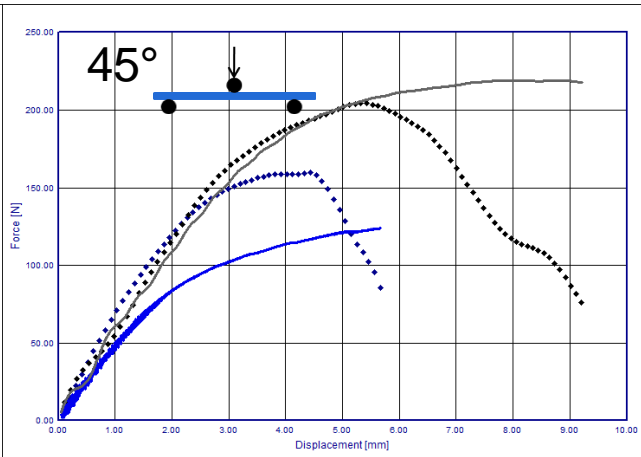
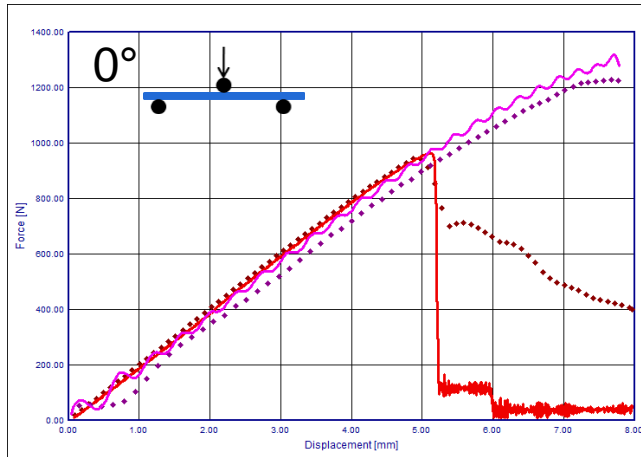
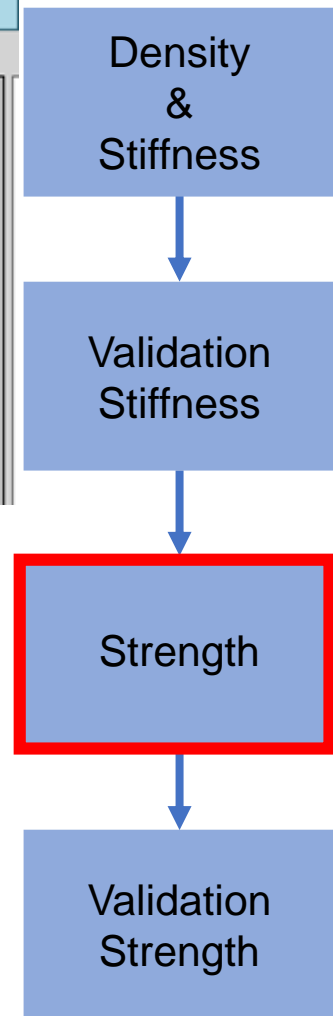
0.1 mm/s 3.5 m/s

0.1 mm/s 2.5 m/s

VALIMAT™ - composites Example GFK

- Strength on UD 9 layers
 - Definition of layers
 - Simulation of tests with the values of UD 9 layers and values for strength
 - Optimization of strength material properties if necessary

MaterialID	Thickness	angle
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0
1000000	1	0



0.1 mm/s 3.5 m/s

0.1 mm/s 2.5 m/s

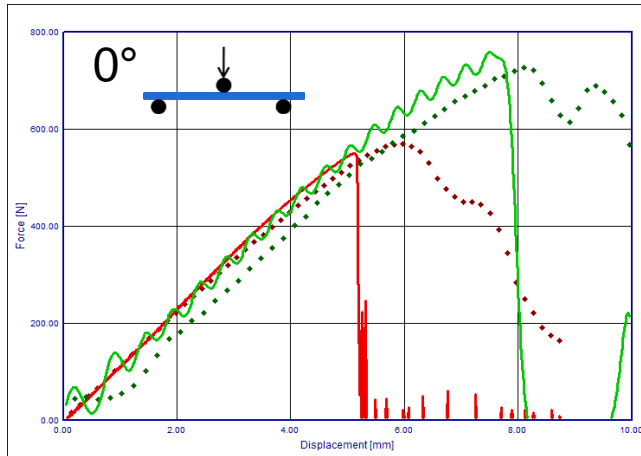
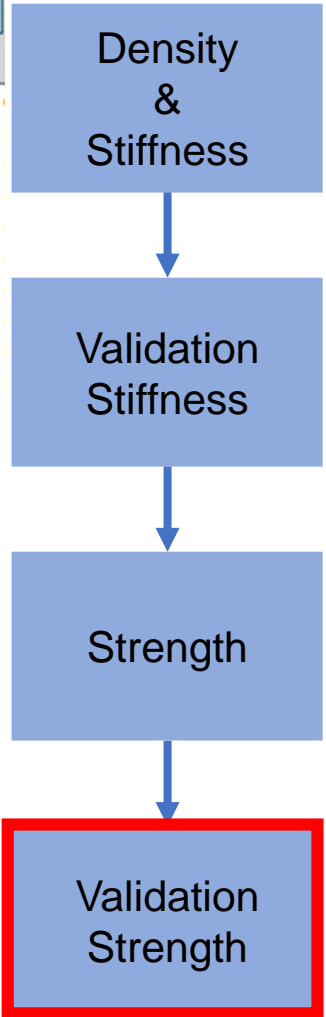
VALIMAT™ - composites Example GFK

- Strength on MD 8 layers
 - Definition of layers
 - Simulation of tests with the values of UD 9 layers

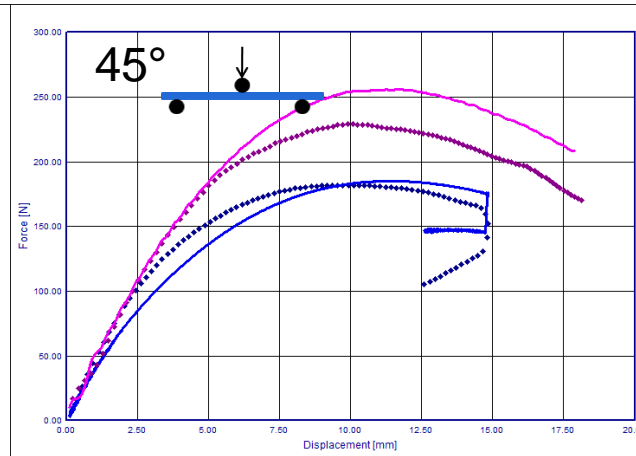
Parameter model* Model database

180910_011 Material Designvariables Layers

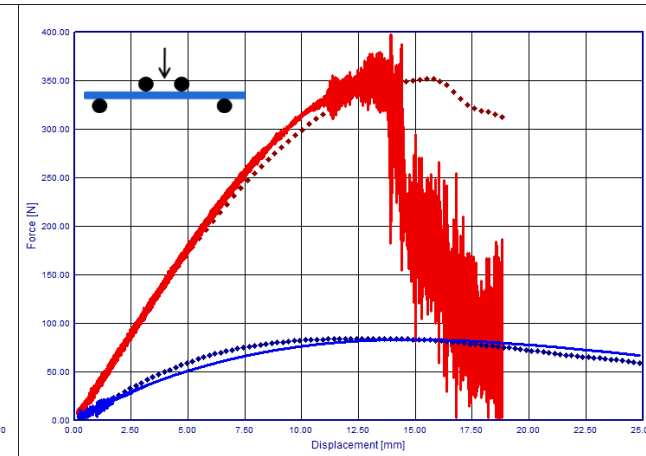
MaterialID	Thickness	angle
1000000	1	0
1000000	1	90
1000000	1	0
1000000	1	90
1000000	1	90
1000000	1	0
1000000	1	90
1000000	1	0



0.1 mm/s 3.5 m/s



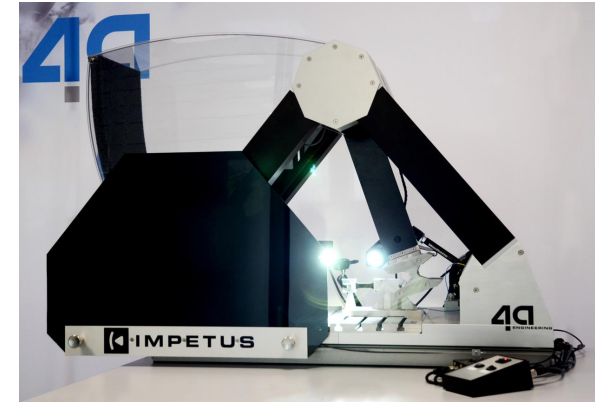
0.1 mm/s 2.5 m/s



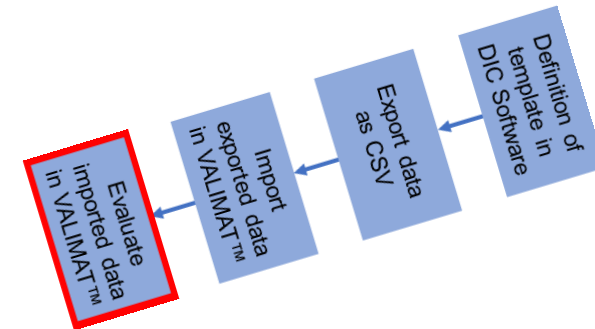
0° 45°

Summary

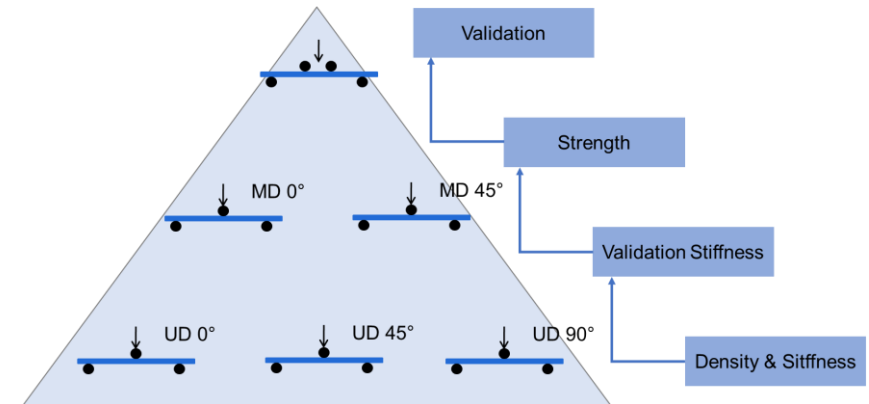
- IMPETUS™ - dynamic tensile test
The easy way to conduct dynamic tensile tests



- VALIMAT™ - handling test data
The easy to use software to manage nearly all test setups



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The easy workflow to generate material cards for composites



Thank you for your attention