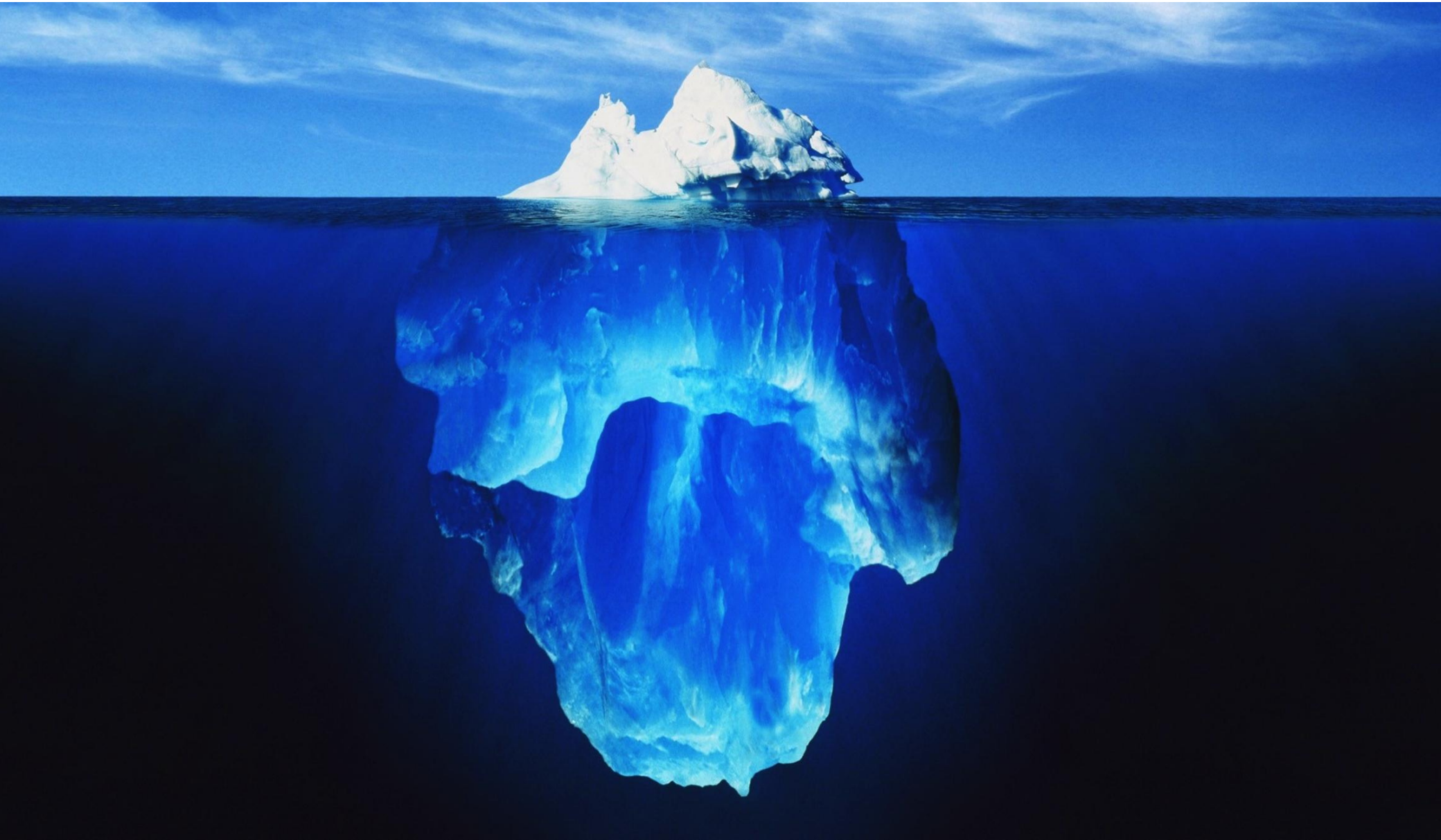



Additive Manufacturing – 3D Printer Technology

Middle Eastern Partnership in Sustainable Engineering – Tempus project
LLL Workshop on 24th of March 2014
Birzeit University – Palestine

Dipl.-Ing. Bernd Muschard







*„The potential advantages and impacts for the industry
and end-users are metaphorically
comparable to an iceberg – we do not exactly know most
of its potential yet.“*

Potentials of Structure and Design

Bionic Structures

Light-Weight Structures

Individual Design

Functional Driven Design

Complex Geometries

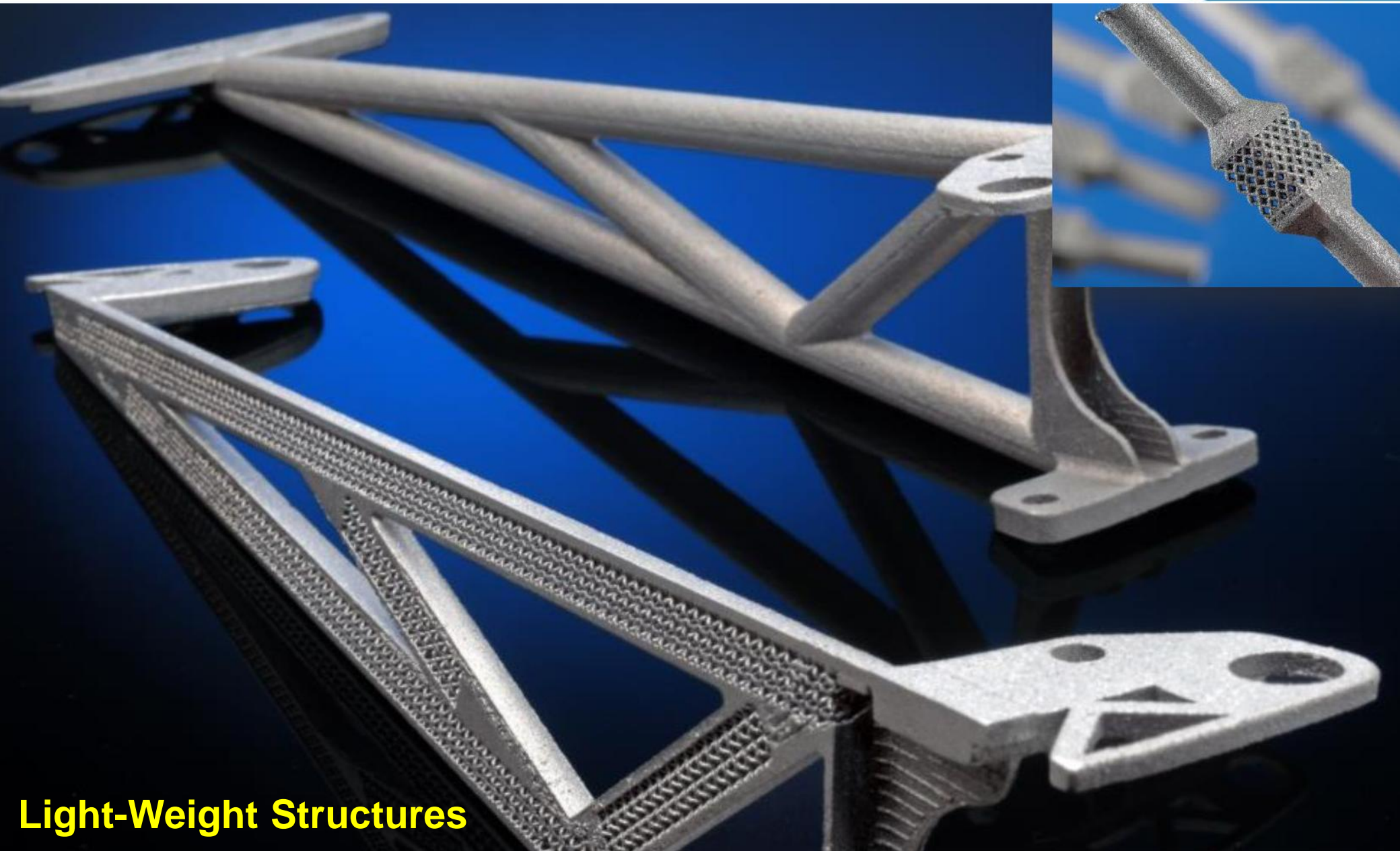
Tailored Structures

Self-Healing Structures

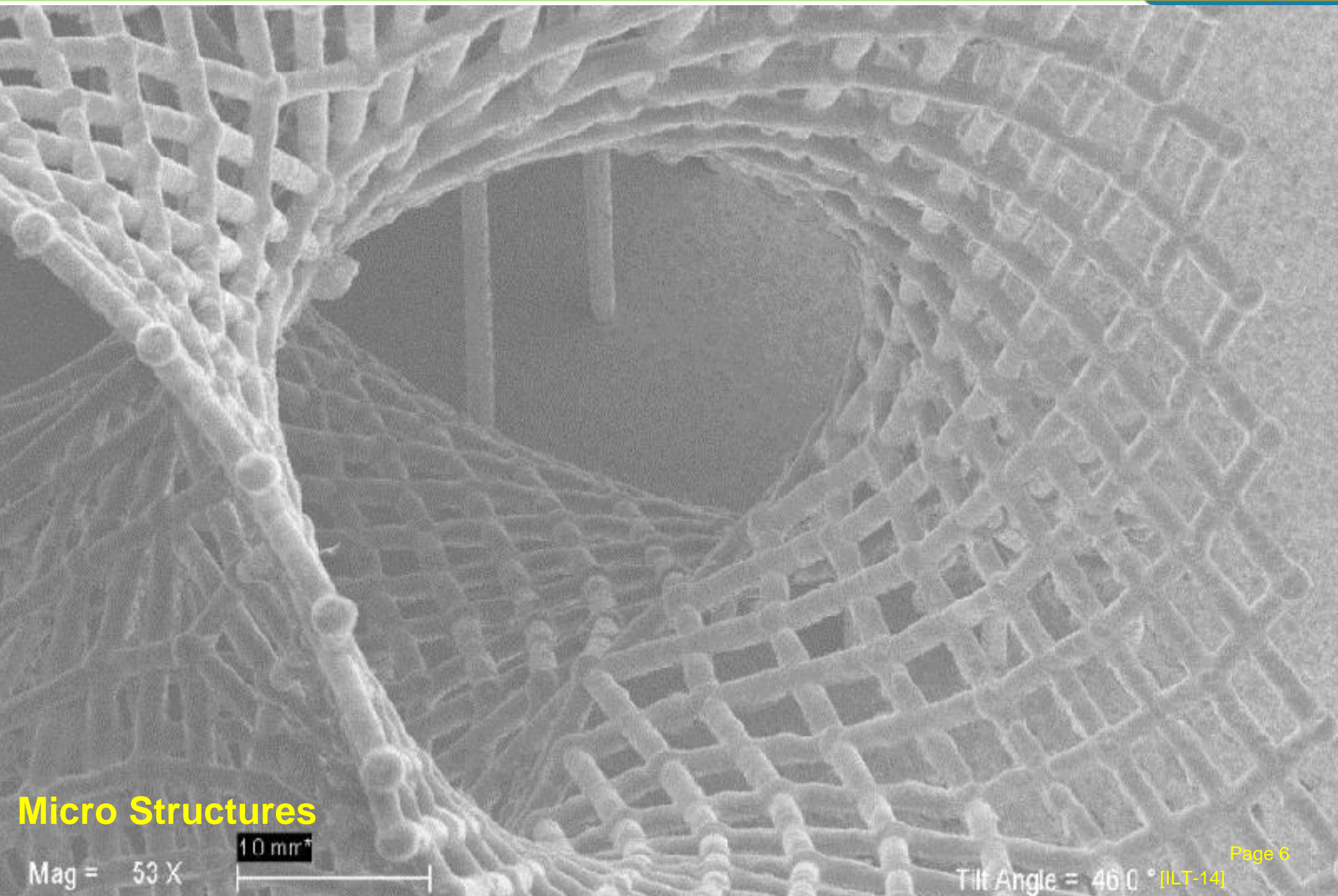
Micro Structures

Energy-Saving Structures

Ergonomic Structures



Light-Weight Structures



Micro Structures

Mag = 53 X

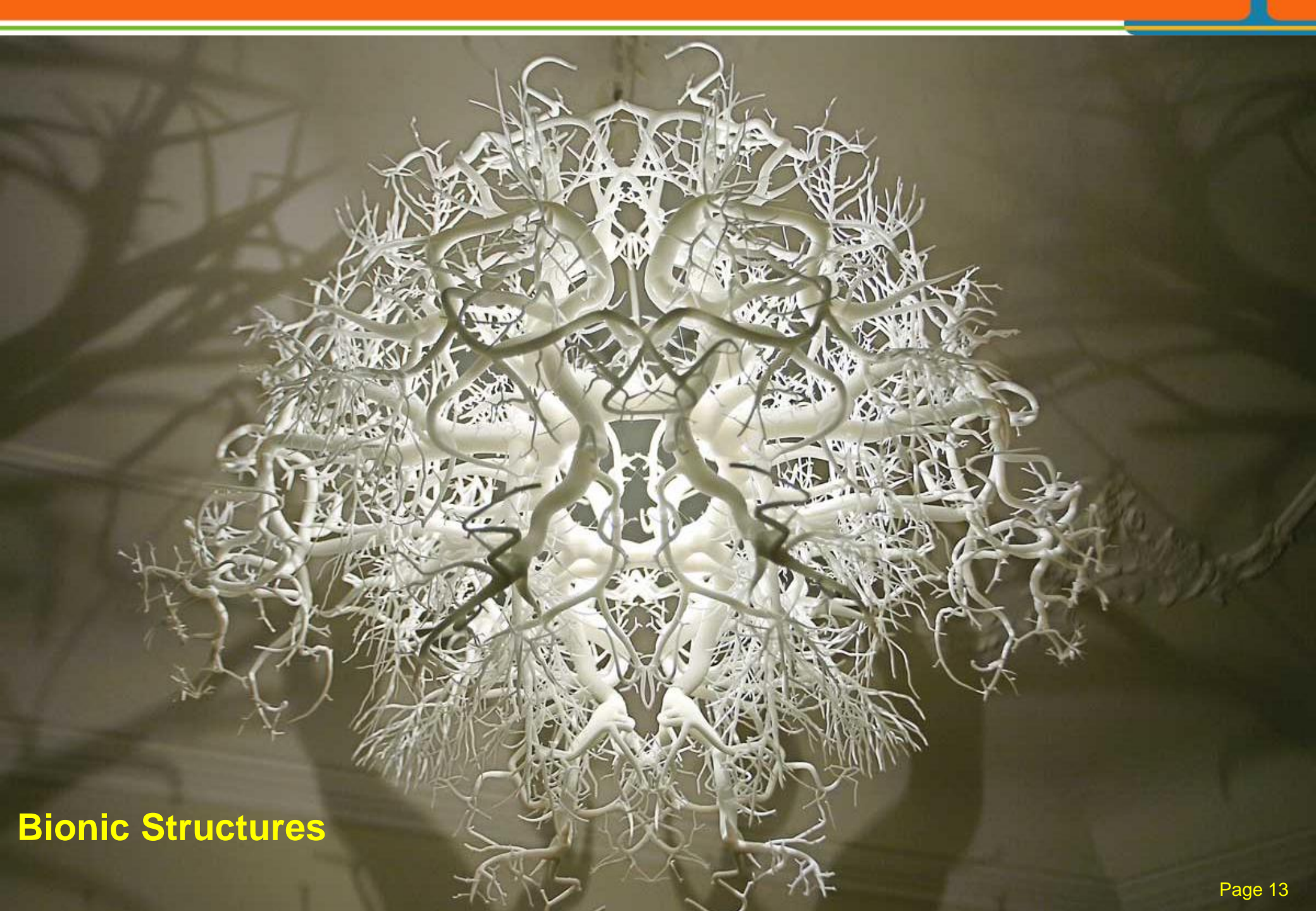
10 mm[†]

Tilt Angle = 46.0 ° [ILT-14]



Complex Geometries

Complex Geometries



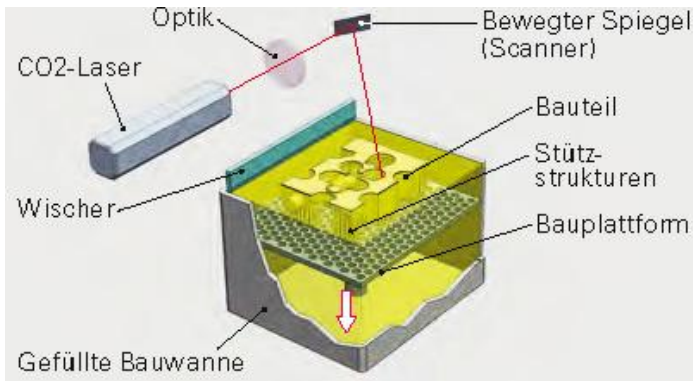
Bionic Structures



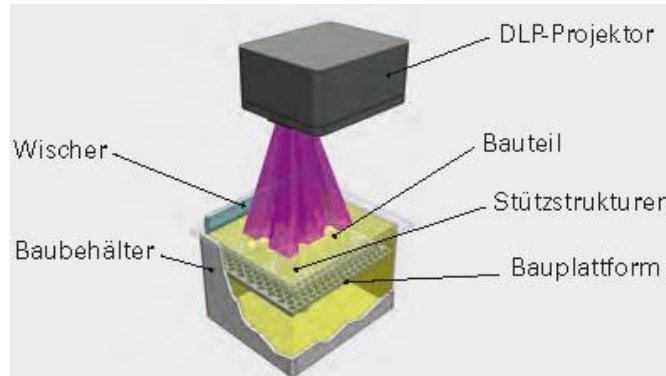
Individual Design

How does it work?

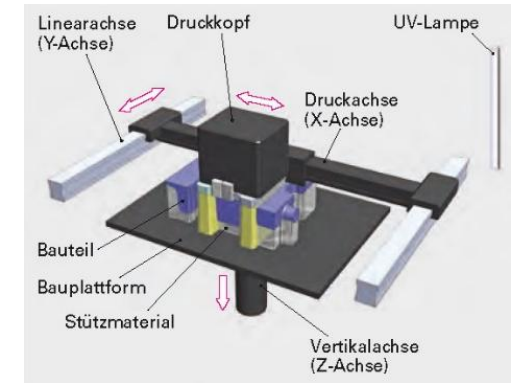
Additive Manufacturing Technologies



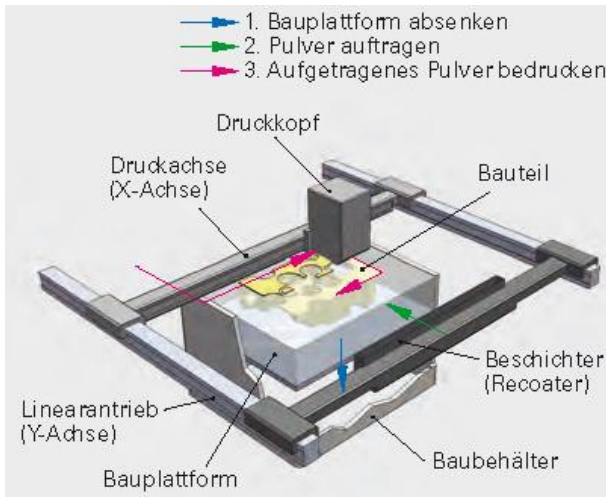
Stereolithografie (STL/SLA)



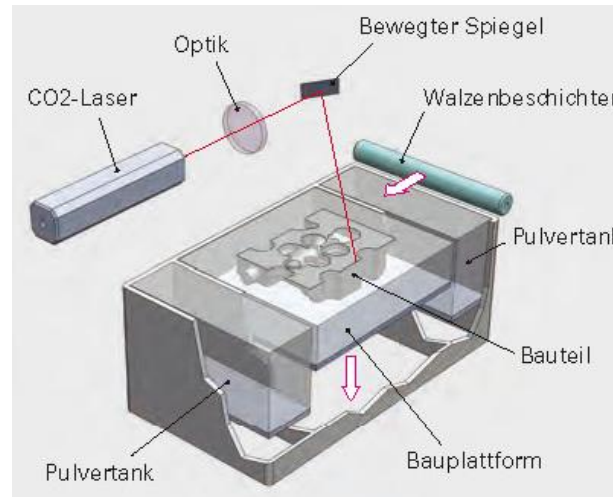
Digital Light Processing (DLP)



Poly-Jet Modeling (PJM)



3D Printing (3DP)

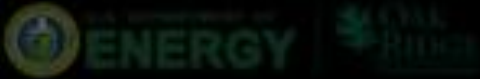


Selective Laser Sintering (SLS)

- ▶ Electro Beam Melting (EBM)
- ▶ Fused Deposition Modeling (FDM)
- ▶ Laminated Object Modelling (LOM)
- ▶ Multi Jet Modeling (MJM)
- ▶ Laser Metal Deposition (LMD)
- ▶ Laser Additive Manufacturing (LAM)
- ▶ u.v.a.

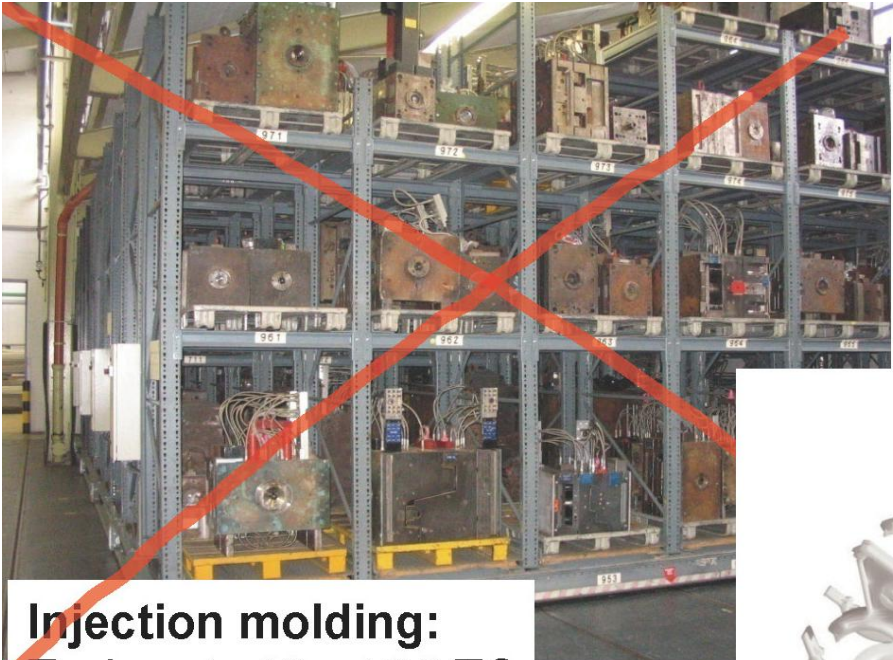
Electron Beam Melting by ARCAM

Turbine



Advantages

Applications faster and cheaper



Injection molding:
Tool costs 10 – 500 T€

(Werksbild Hella KGaA 2009)



Rubber boot sole
(EOS & Tecnologia & Design)

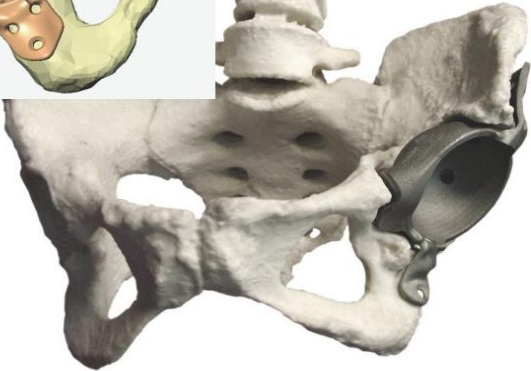
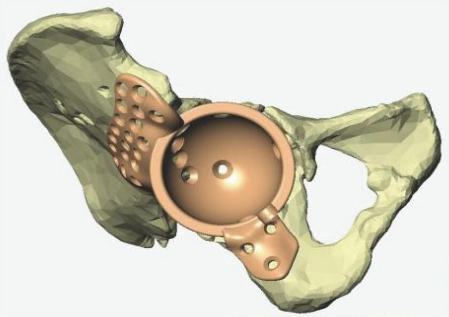


Cable clips
(EOS)



Prototype of a fuel tank
(EOS, FKM Sintertechnik)

Individual Applications



Artificial hip joint
(SLM Solutions)



Tooth crowns
(SLM Solutions)



Artificial leg
(EOS & Fraunhofer)



Designer sun glasses
(small series)
(EOS, Tecnologia & Design - Treviso Tecnologia)

Complex Applications



Pre-series tool for VW Golf control panel
(EOS, Moldes Royas)



Casting core for gear boxes
(EOS, Poggipolini)



Aerospace parts
(EOS, Morris Technologies)

Industrial Applications

Aerospace



Dental



Jewelry



Automotive



Tool/mold making



Implants



Armaments

Industries

Electronics



Specialty food



Furniture



Surgical devices/aids



Sports equipment



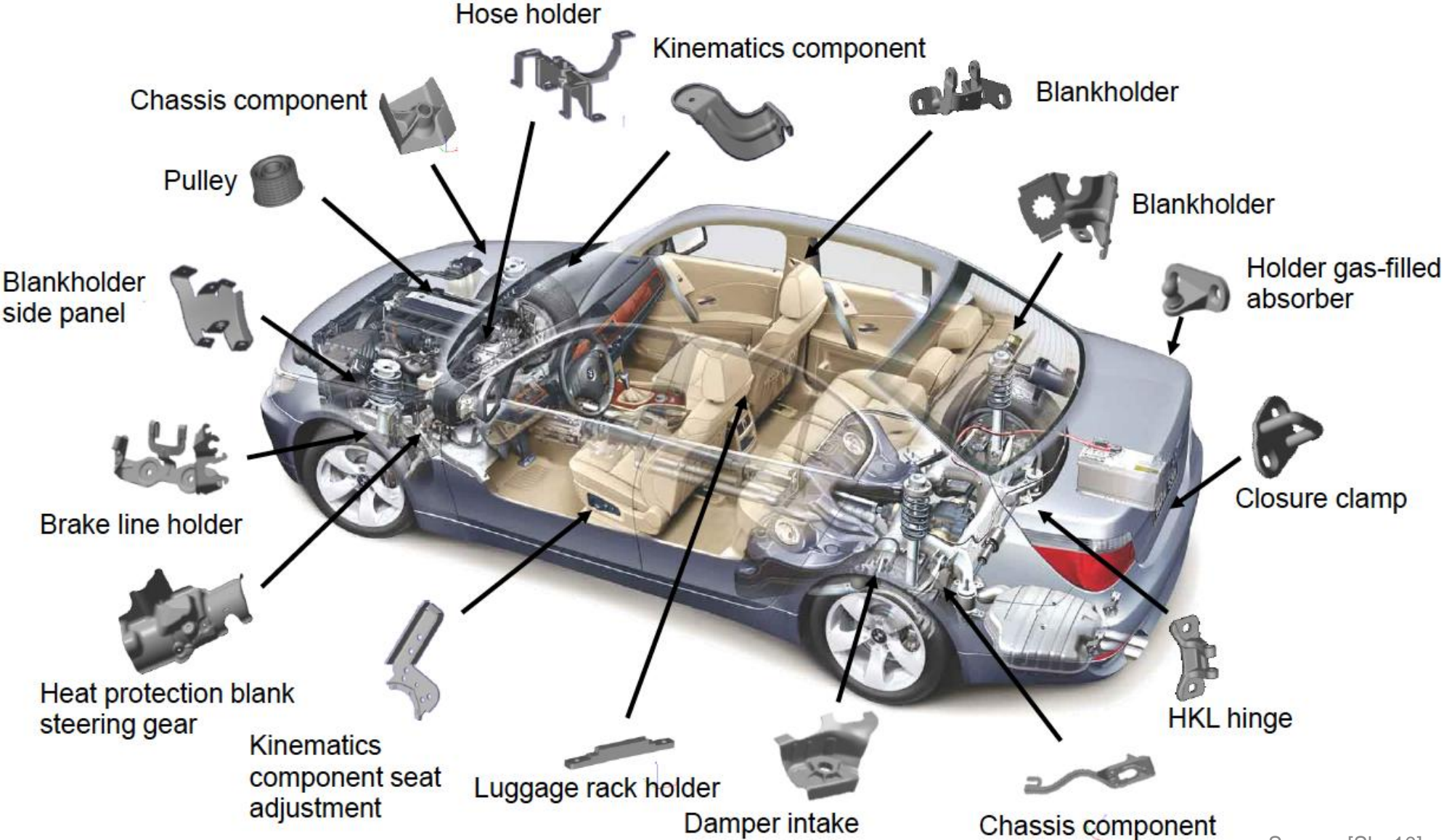
Toys/collectables



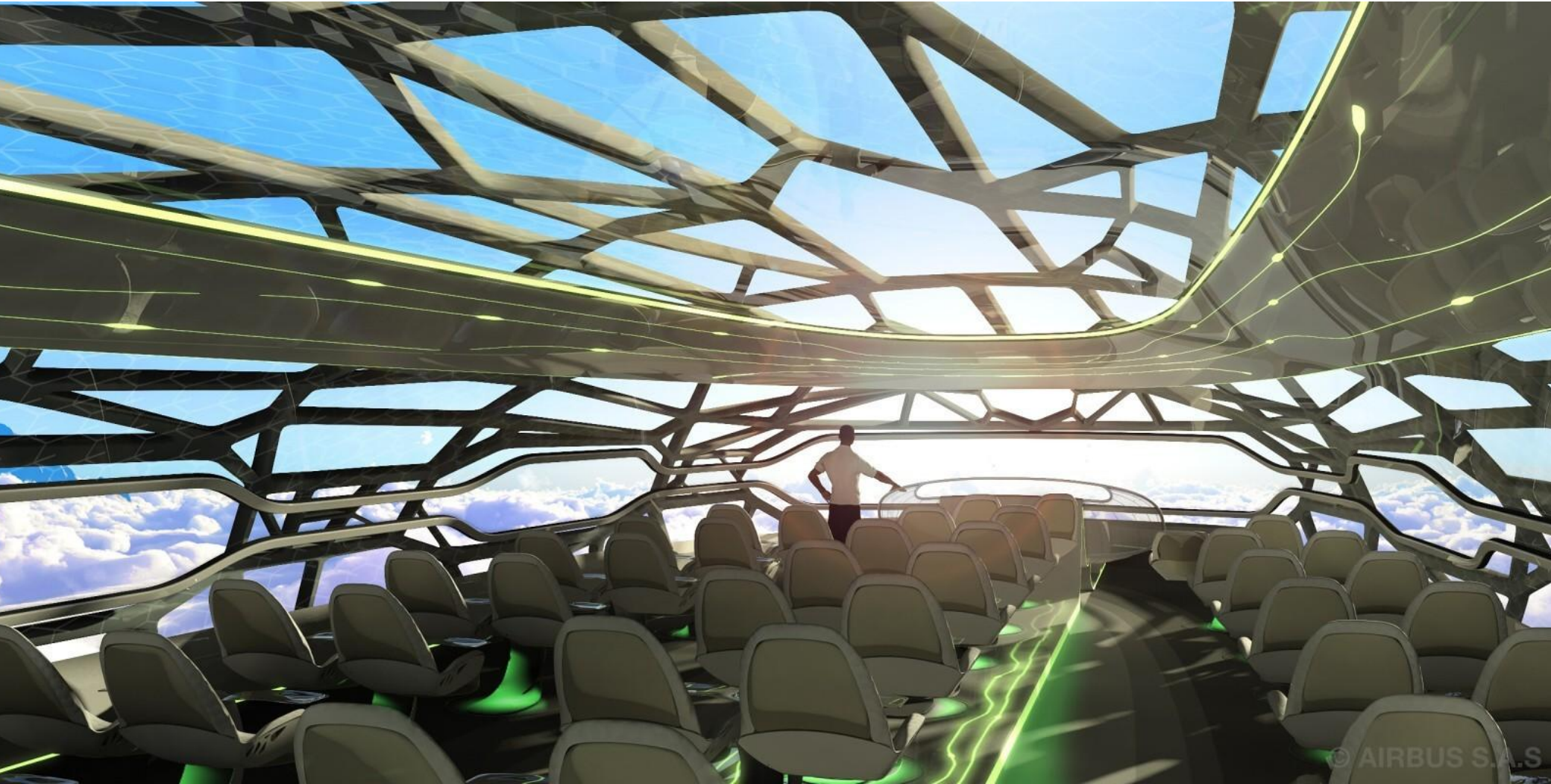
Textiles



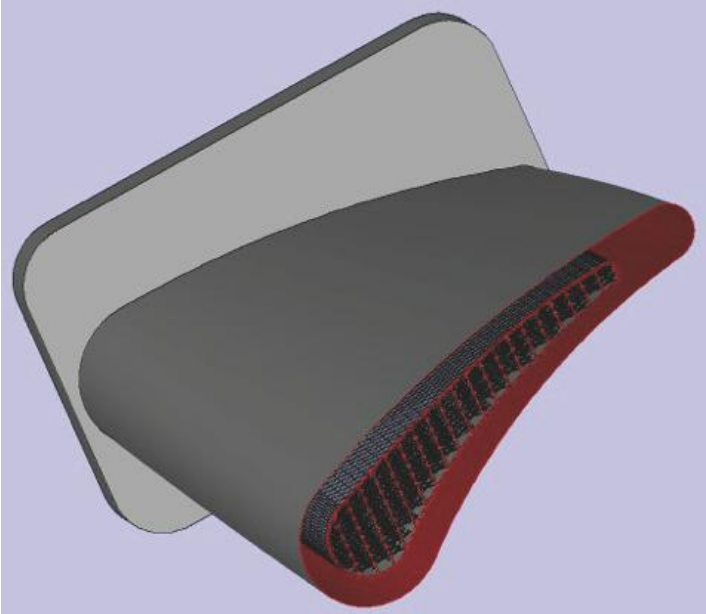
Automotive Industry – Laser Additive Manufacturing (LAM)



Aerospace Industry



Inner Tailored Structures



Airbus A380



- ▶ 1kg weight reduction of an airplane
 - ▶ Fuel savings of \$ 3.000 per year
- ▶ Reduction potential of CO2 emissions by 40 percent

SLM-Dental Reconstruction

Worldwide first industrial application was made by Fraunhofer ILT

















- Reconstruction of single teeth
- Process steps:
 - Preparation
 - Model
 - Digitalization
 - Design (CAD)
 - Manufacturing
 - Control of model
 - Ceramic cover
- Production start
 - Nov. 2002




















Additive Manufacturing

...a short list.

















































List of available Printers

Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pros- umer	Ind- ust- rial	Price € / \$
	3Doodler	3D Printing Pen			FFF		99 \$
	3Dsimo	3D Printing Pen			FFF		85 \$
	3DYAYA	3D Printing Pen			FFF		112 \$
	SwissPen	3D Printing Pen			FFF		84 €
	3D Systems (Bits from Bytes)	RapMan 3.2 3D Printer Kit Education			FFF		1610 €
	3D Systems (Bits from Bytes)	RapMan 3.2 3D Printer Kit Extreme (NBHE)			FFF		1030 €
	3D Systems (Bits from Bytes)	RapMan 3.2 3D Printer Kit Ultimate (DH-NS)			FFF		1450 €
	3D Systems (Bits from Bytes)	RapMan 3.2 3D Printer Kit Universal (BH-E-NS)			FFF		1190 €
	Adjunct Engineering	Printxel			FFF		
	Bart Dring	Quantum Delta			FFF		
	Blue Eagle Labs	Kossel Clear Delta			FFF		550 \$
	Bootsindustries	BI V2.0 Delta Printer			FFF		685 \$
	Boris Landoni	3Drag 3D-Printer			FFF		
	Conrad / Renkforce	Renkforce RF1000			FFF		1499 €
	David Akers	Rappi Delta			FFF		
	David Akers	Rappi Delta Jr.			FFF		327 €

















































Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pros- umer	Ind- ust- rial	Price € / \$
	David Hartkop	Mini Metal Maker			-		750 \$
	Deezmaker	Bukito portable			FFF		649 \$
	Deezmaker	Bukobot			FFF		
	Deltamaker	Delta Robot			FFF		
	Deltaprinter	Deltaprinter			FFF		685 \$
	DeltaTrix	DeltaTrix 3D Printer			FFF		700 €
	Duy Dang	Eventorbot			FFF		
	EchoFab	EchoRap			FFF		
	Ez3D	Phoenix 3D Printer			FFF		374 \$
	fab@home	fab@home Model 1			FFF		
	fab@home	fab@home Model 2			FFF		
	FABotom	Personal Fabricator			FFF		1099 \$
	Felix Printers	Felix 1.5 DIY Kit			FFF		899 €
	Gary Hodgson	DLP Resin			DLP		
	German Reprap GmbH	GRRR PRotos V2			FFF		799 €
	German Reprap GmbH	GRRR PRotos X400			FFF		2259 €

Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pros- umer	Ind- ust- rial	Price € / \$
	German Reprap GmbH	NEO			FFF		799 €
	German Reprap GmbH	Prusa			FFF		749 €
	Gordon LaPlante	gMax 3D Printer			FFF		1795 \$
	Ilios	IID SLA 3D-Drucker			DLP		3500 €
	Imprints 3D	Smartrap 3D Printer			FFF		300 €
	Isis3D	Isis One Desktop 3D Printer			FFF		
	Jelwek	Mark34 3D Printer			FFF		
	Junior Veloso	DIY High-Res Stereo-lithographic Printer			SLA		
	Justin Hawkins	sLAMPS			SLA		
	Kühling & Kühling	RepRap Industrial			FFF		
	Lunavast	XG2			DLP		
	MakeMendel	RapidBot 1.0 / 2.0 / 3.0			FFF		1250 \$
	MakeMendel	RapidBot Mega			FFF		699 \$
	Marin Davide	LumiFold			SLA		390 \$
	Mauk	Cartesio			FFF		1755 €
	Michael Lundwall	RigidBot 3D Printer			FFF		

















































List of available Printers

Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$		
	RepRap Austria	Prusa I3 Graber			FFF		849		Sedwick	Open Source DLP						Michael Lundwall	RigidBot BIG 3D Printer				FFF				
	RepRap Austria	Rostock			FFF		799		Sintermask	Fabbster			FFF		1699	€		Michal Liberta	GolemD			FFF			
	RepRap Diffusion	Tobeca 3D Printer			FFF		899		Terawatt Industries	PrismX 3D Printer			FFF		1195	\$		Multtec	Multirap			FFF	928	€	
	RepRap Project	Darwin			FFF				Tinkerine Studio	Ditto			FFF		899	\$		mUve 3D	MUVe 1 3D Printer			SLA		999	\$
	RepRap Project	FoldaRap			FFF				Tijko Labs	The Snap 3D Printer			FFF		799	\$		OpenBeam	Kossel Pro 3D Printer			FFF		1000	\$
	RepRap Project	Huxley			FFF				TrinityLabs	Aluminatus TrinityOne			FFF		2199	\$		Printmate3D	printMATE 3D Drucker			FFF		950	€
	RepRap Project	Mendel			FFF				TU-Wien	Micro Printer			SLA					Printrbot	Printrbot Jr			FFF		399	\$
	RepRap Project	Mendel Max			FFF				Ultimaker	Ultimaker 2			FFF		2500	\$		Printrbot	Printrbot Jr v2			FFF		630	\$
	RepRap Project	Prusa			FFF				Ultimaker	Ultimaker Original			FFF		1194	€		Printrbot	Printrbot PLUS			FFF		999	\$
	RepRap Project	Simpson			FFF				Velleman	Velleman 3D Drucker- Bausatz K8200			FFF		699	€		Printrbot	Printrbot Simple			FFF		299	\$
	RepRap Project	Tantillus			FFF				William Steele	Ultra Bot			FFF					Project Tinbox	Tinabox 3D Printer			FFF			
	ReprapPro	Omerod / RS Components			FFF		605	€		York 3D	Buildabot Revolution			FFF		1150	€		re:3D	Gigabot 3D Printer			FFF	2500	\$
	ReprapPro	Tricolour Mendel			FFF		940	€		2PrintBeta	Printupv 3D-Drucker			FFF		1200	€		RepeMaker	RepeMaker 3D Printer			FFF		
	Rinnovated Design	Peachy Printer			SLA		72	€		3DMonstr	T-Rex-12 T-Rex-18 T-Rex- 24			FFF		2499	\$		Replicator Warehouse	R-360			FFF	420	
	RoBo	RoBo 3D-PRINTER			FFF		520	\$		3D Systems	ChefJet			Food		5000	\$		RepRap Austria	Mendel Max			FFF	799	
	Rostock	Delta Robot			FFF					3D Systems	Cube 2			FFF		1569	\$		RepRap Austria	Prusa			FFF	699	

















































List of available Printers

Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pros- umer	Ind- ust- rial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pros- umer	Ind- ust- rial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pros- umer	Ind- ust- rial	Price € / \$
	3ntr	A4 3D Printer			FFF				Choc Edge	Choc Creator			Food			3D Systems	Cube 3			FFF			1000 \$
	ACME Design	Monolith 3D Printer			SLA		14950 \$		Code P-West	3D Builder			FFF			3D Systems	Cube Pro 2			FFF			5000 \$
	Acuity Design	Helix 3D Printer			FFF		4850 \$		Delta Tower	Delta Tower 3D-Drucker			FFF			3D Systems	CubeX			FFF			2615 \$
	Afinia	H-Series			FFF		1599 \$		DWS Labs	Xfab Laser 3D Printer			SLA			3D Systems	Projet 1000			FFF			
	Airwolf 3D	AW-XL			FFF		2295 \$		E-crew vis	ECV-One			FFF			3D Systems	Projet 1500			FFF			
	Airwolf 3D	AW3D HD			FFF		2995 \$		Essential Dynamics	Imagine 3D-Printer			Food			3D Systems (Bits from Bytes)	3DTouch 3D Printer (Double Head)			FFF			2920 €
	Aleph Objects	LulzBot AO-101			FFF		1725 \$		Fablicator	Fablicator			FFF			3D Systems (Bits from Bytes)	3DTouch 3D Printer (Single Head)			FFF			2590 €
	Aleph Objects	LulzBot TAZ			FFF		2195 \$		Felix Printers	Felix 1.5 Assembled			FFF			3D Systems (Bits from Bytes)	3DTouch 3D Printer (Triple Head)			FFF			3240 €
	Aleph Objects	LulzBot TAZ 2			FFF		2395 \$		File2Part	Gutenberg			FFF			3D Systems (Bits from Bytes)	3DTouch 3D Printer Education Pack			FFF			3230 €
	be3D	DecOrange			FFF		1600 €		Flashforge / Cardcon Systems	Creator / Conbot DUAL 3D Drucker			FFF			3D Systems (Bits from Bytes)	3DTouch 3D Printer Hobby Pack			FFF			3020 €
	BeeVery Creative	Bee TheFirst 3D Printer			FFF		1805 €		Ford Collins	EZ3D Desktop Printer			FFF			3Dfactories	Easv 3Dmaker			FFF			
	BigRep	BigRep One			FFF		39000 \$		Full Spectrum Laser	Pegasus Touch Laser			SLA			3Dfactories	Maxi 3DPrinter			FFF			
	Builder 3D	Big Builder			FFF		2495 €		German Reprap GmbH	X400 CE			FFF			3Dfactories	Profi 3DMaker			FFF			
	Brahma3	Anvil 3D Printer			FFF		1172 €		Hase	HAGE 3Dp-A2 3D Drucker			FFF			3Dfactories	ProProfi 3DPrinter			FFF			
	CB Printer	CB Printer			FFF		1550 €		Hvrel 3D	System 30			FFF			3Dfactories	Visions 3DPrinter			FFF			
	CEL	Robox 3D Printer			FFF		1000 €		Hvrel 3D	The Hvrel			FFF			3Dkits	Status 3D Printer			FFF			1850 €

















































List of available Printers

Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pros- umer	Ind- ustrial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pros- umer	Ind- ustrial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pros- umer	Ind- ustrial	Price € / \$
	Makers Tool Works	Fusermatic 3D			FFF		799 \$		Pirate3D	The Buccancer 3D-Printer			FFF			Ion Core	Zinter Pro 3D Printer			FFF		2800 €	
	Makible	MakiBox A6			FFF		350 \$		Plastic Scribber	Asterid 1000S / 1000HB 3D Printer			FFF	549 \$		iRapid	iRapid BLACK			FFF		999 €	
	Makism 3D	Wideboy 3D Printer			FFF				PowerWasp	Personal Fab			FFF	990 €		Japica	J-Rev 3D Printer			FFF		1850 \$	
	Marcha Technology	Witbox Helios (2X)			FFF		2500 €		pp3dp	Up! Mini			FFF	899 \$		Kikai Lab	Kikai 3D Printer			FFF			
	MarkForget	Mark One Carbonfaser			CFE		5000 \$		pp3dp	Up! Plus			FFF	1499 \$		Kinpo Group	da Vinci 1.0			FFF		365 €	
	Mbot 3D	Cube			FFF		999 \$		pp3dp	Up! Plus 2			FFF	1649 \$		Leapfrog	Creatr			FFF		1250 €	
	Mbot 3D	GRID II			FFF		1395 €		Printrbot	Printrbot Simple Metal			FFF	\$		Leapfrog	Creatr XL			FFF		€	
	Michael Joyce	B9Creator			DLP		2795 \$		QU-BD	Revolution			FFF	799 \$		Leapfrog	Xeed			FFF		8400 €	
	Miiicraft	Miiicraft 3D Printer			SLA		2299 \$		Radiant Fabrication	Lionhead 3D Printer All-in-One			FFF	1649 \$		LightForge	DLP 3D Printer			DLP		2500 \$	
	Natural Machines	Foodini			Food		945 €		Rapide 3D	Rapide One 3D Printer			FFF	1499 \$		M3D	The Micro 3D Printer			FFF		199 \$	
	Omni3D	RapCraft 3D Printer			FFF		1656 €		Riwell Enterprises / FreeSculpt	Myriwell / 3D FreeSculpt EX1-Basic			FFF	1099 €		MakerBot	Mini			FFF		1375 \$	
	Opencube	Scoovo C170			FFF				Robotfactory	3D-One			FFF			MakerBot	Replicator 2			FFF		2199 \$	
	ORD Solutions	BTO1001 R2 3D Printer			FFF				Romscraj	Portabee Go			FFF			MakerBot	Replicator 2X			FFF		2799 \$	
	OWL	Nano 3D Printer			SLA		4900 \$		SeeMeCNC	Orion Delta 3D Printer			FFF	1499 \$		MakerBot	Replicator 3			FFF		2899 \$	
	Pearl	Colani 3D-Drucker			FFF				Sharebot	Next Generation Desktop 3D Printer			FFF	1400 €		MakerBot	Replicator Z18			FFF		6499 \$	
	Picaso 3D	Designer			FFF		2200 €		SkyForge	Tritium Delta			FFF	2999 \$		Maker Dreams	iNvent One			FFF		725 €	

















































List of available Printers

Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$
	Vader Systems	Vader Mark 1 Liquid Metal Jet Printer				LMJP			3D Systems	ProJet 3500 CPXMax				FFF		Solidator	DLP Desktop 3D Printer				DLP	4950	\$
	Weistek	D-Master				FFF			3D Systems	ProJet 3500 HDMax				FFF		Solidoodle	Solidoodle 3D Printer 2.Generation				FFF	499	\$
	Weistek	Deskretator				FFF	490 €		3D Systems	ProJet 360				3DP		Solidoodle	Solidoodle 3D Printer 3.Generation				FFF	799	\$
	Weistek	IdeaFab				FFF	512 €		3D Systems	ProJet 4500				CJP		Solidoodle	Solidoodle 3D Printer 4.Generation				FFF	999	\$
	Weistek	X-Master				FFF			3D Systems	ProJet 460Plus				3DP		Stratasys	Mojo				FDM	9900	\$
	Zeepro	Zim 3D-Drucker				FFF			3D Systems	ProJet 5000				FFF		Stratasys	uPrint SE				FDM	15900	\$
	Zmorph	Personal Fabricator				FFF			3D Systems	Projet 5500X				MJP		Stratasys	uPrint SE plus				FDM	20900	\$
	Zortrax	M200 Professional Desktop 3D Printer				FFF	1899 \$		3D Systems	ProJet 660Pro				3DP		Stratasys (Fortus)	Fortus 250mc				FDM		
	3D Labs GmbH	M120 SLT				SLT			3D Systems	ProJet 860Pro				3DP		Stratasys (Objet)	Objet24 Personal 3D Printer				FDM		
	3D Systems	iPro™ 8000				SLA			3D Systems	ProJet CP 3500				FFF		Stratasys (Objet)	Objet30 Desktop 3D Printer				FDM		
	3D Systems	iPro™ 8000 MP				SLA			3D Systems	ProJet CPX 3500 (Plus)				FFF		Tumaker	Voladora 3D Printer				FFF	1500	€
	3D Systems	iPro™ 9000				SLA			3D Systems	ProJet DP 3500				FFF		Trimaker	T-Black				DLP	3650	€
	3D Systems	iPro™ 9000 XL				SLA			3D Systems	ProJet HD 3500 (Plus)				FFF		Types A Machines	Series 1 2014				FFF	2295	\$
	3D Systems	ProJet 1200 Micro SLA				SLA	4900 \$		3D Systems	ProJet HD 6000				SLA		Types A Machines	Series 1 New				FFF	1695	\$
	3D Systems	ProJet 160				3DP			3D Systems	ProJet HD 7000				SLA		Types A Machines	Series 1 Pro				FFF		
	3D Systems	ProJet 260C				3DP			3D Systems	ProJet MP 3500				FFF		Unica 3D	QS-1 DLP				DLP	999	\$

List of available Printers











Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$
	Almteq	Master+plus J				DLP			DWS	Digitalwax 008D				SLA			3D Systems	ProJet MP 6000				SLA	
	Almteq	Master+plus M				DLP			DWS	Digitalwax 008J				SLA			3D Systems	ProJet MP 7000				SLA	
	Almteq	Master+plus S				DLP			DWS	Digitalwax 028D				SLA	55000 €		3D Systems	ProJet SD 3500				FFF	
	Arcam AB	Arcam A1				EBM			DWS	Digitalwax 028J				SLA	45000 €		3D Systems	ProJet SD 6000				SLA	
	Arcam AB	Arcam A2				EBM			DWS	Digitalwax 028J+				SLA	55000 €		3D Systems	ProJet SD 7000				SLA	
	Arcam AB	Arcam Q10				EBM			DWS	Digitalwax 029D				SLA	99000 €		3D Systems	ProX 500				SLS	
	Arcam AB	Arcam Q20				EBM			DWS	Digitalwax 029J				SLA	89000 €		3D Systems	ProX 950				SLA	
	Asiga	Freeform Pico (Plus)				SLA	6990 \$		DWS	Digitalwax 029J+				SLA	99000 €		3D Systems	sPro™ 125 Direct Metal				SLS	
	be3D	DecRed				FFF	16800 €		DWS	Digitalwax 029X				SLA	109000 €		3D Systems	sPro™ 140				SLS	
	Beijing Tiertime Technology	Inspire A370				FFF			DWS	Digitalwax 030D				SLA			3D Systems	sPro™ 230				SLS	
	Beijing Tiertime Technology	Inspire A450				FFF			DWS	Digitalwax 030J				SLA			3D Systems	sPro™ 250 Direct Metal				SLS	
	Beijing Tiertime Technology	Inspire D255				FFF			DWS	Digitalwax 030X				SLA			3D Systems	sPro™ 60 HD				SLS	
	Beijing Tiertime Technology	Inspire D290				FFF			envisionTEC	3D - Bioplotter				BIO			3D Systems	sPro™ 60 SD				SLS	
	Beijing Tiertime Technology	Inspire S200				FFF			envisionTEC	3Dent				SCP			3D Systems	V-Flash				FFF	
	Beijing Tiertime Technology	Inspire S250				FFF			envisionTEC	AUREUS				DLP			3D Systems (Z Corporations)	ZBuilder Ultra				SLA	
	Concept Laser	Mlab Cusing R				SLS			envisionTEC	Micro				DLP			AAROFLEX	AACURA 22 Solid State				SLA	

List of available Printers

Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$	Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pro- sumer	Ind- ust- rial	Price € / \$		
	ExOne	S-Print							Phenix Systems	PXM							envisionTEC	Perfactory DDP4							
	Formatec	Ceramics							Phenix Systems	PXS							envisionTEC	Ultra2							
	Groupe Gorgé	Prodways D35							Rapid Shape	rapidshape S60 maxi							envisionTEC	Xcdc 3SP							
	Groupe Gorgé	Prodways K20							Rapid Shape	rapidshape S60 midi							eos	EOSINT M 280							
	Groupe Gorgé	Prodways M350							Rapid Shape	rapidshape S60 mini							eos	EOSINT P 395							
	Kevvox	SP4300							Realizer	SLM 100							eos	EOSINT P 760							
	Kevvox	SP6200							Realizer	SLM 250							eos	EOSINT P 800							
	Lithoz	CeraFab 7500							Realizer	SLM 50							eos	EOSINT S 750							
	LUMEX Mitsubishi	Avance-25 Metal					850000 \$		Renishaw	AM125							eos	EOSINT S 750							
	meor technologies	Iris							Renishaw	AM250							eos	FORMIGA P 110							
	meor technologies	Matrix 300							Robotfactory	3DLPrinter							eos	M 400							
	meor technologies	Matrix 300+							SLM Solutions	SLM 125 HL							eos	P 396							
	Nanoscribe	Photonic Professional GT							SLM Solutions	SLM 250 HL							ExOne	M-Flex							
	Optomec	LENS 450							SLM Solutions	SLM 280 IIL							ExOne	M-Lab							
	Optomec	LENS 850-R							SLM Solutions	SLM 500 HL							ExOne	M-Print							
	Phenix Systems	PXL							Stratasys (Dimension)	Dimension BST 1200es							ExOne	S-Max							

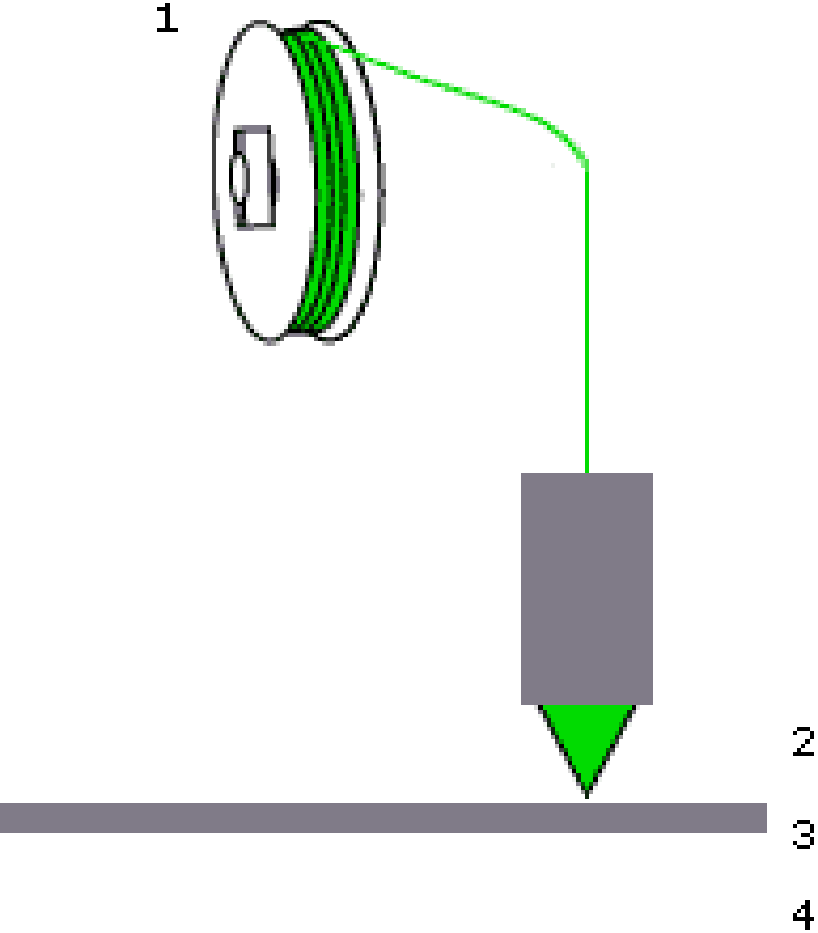
List of available Printers

Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pros- umer	Ind- ust- rial	Price € / \$
	Stratasys (Dimension)	Dimension Elite			FDM		
	Stratasys (Dimension)	Dimension SST 1200es			FDM		
	Stratasys (Fortus)	Fortus 360mc			FDM		
	Stratasys (Fortus)	Fortus 400mc			FDM		
	Stratasys (Fortus)	Fortus 900mc			FDM		
	Stratasys (Objet)	Objet Connex 1000			FDM		
	Stratasys (Objet)	Objet Connex 260			FDM		
	Stratasys (Objet)	Objet Connex 350			FDM		
	Stratasys (Objet)	Objet Connex 500			FDM		
	Stratasys (Objet)	Objet500 Connex3			FMM		240000 €
	Stratasys (Objet)	Objet Eden 260V			FDM		
	Stratasys (Objet)	Objet Eden 260V Dental Advantages			FDM		
	Stratasys (Objet)	Objet Eden350/350V			FDM		
	Stratasys (Objet)	Objet Eden500V			FDM		
	Stratasys (Solidscape)	Solidscape 3Z Edu			FDM (wax)		
	Stratasys (Solidscape)	Solidscape 3Z Lab			FDM (wax)		

Picture	Manu- facturer	Model	Sys- tem	DIY / Kit	Pros- umer	Ind- ust- rial	Price € / \$
	Stratasys (Solidscape)	Solidscape 3Z Max			FDM (wax)		
	Stratasys (Solidscape)	Solidscape 3Z Pro			FDM (wax)		
	Stratasys (Solidscape)	Solidscape 3Z Studio			FDM (wax)		
	voxeljet	VX 1000			3DP		
	voxeljet	VX 200			3DP		
	voxeljet	VX 2000			3DP		
	voxeljet	VX 4000			3DP		
	voxeljet	VX 500			3DP		
	voxeljet	VX 800			3DP		
	voxeljet	VXC 800			3DP		

Low price 3D printer
...the Fused Deposition Modeling (FDM)

Fused Deposition Modeling (FDM)



Print Head Extruder (FDM)

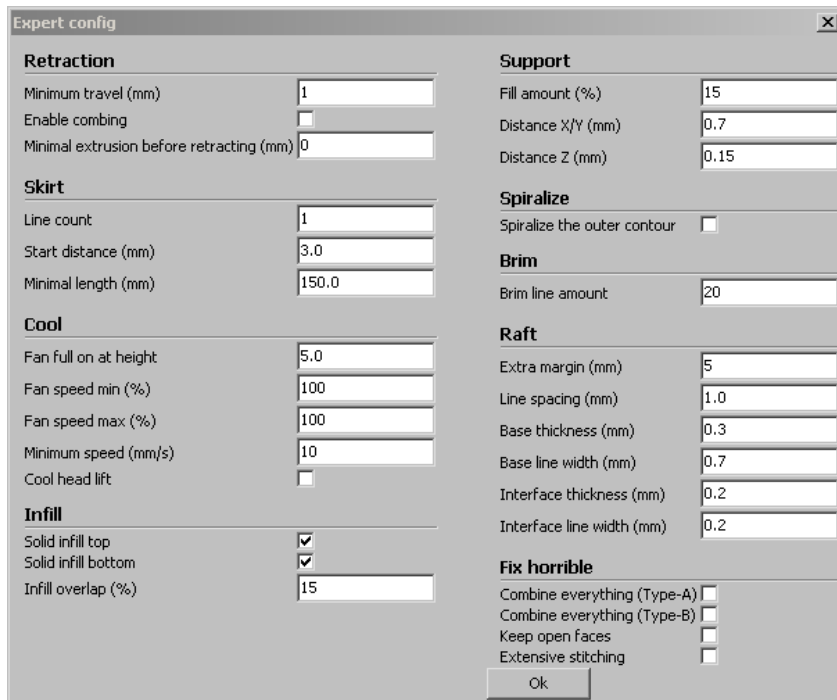


How do I get the model into the printer?
...Slicing with Cura.

Cura – Slicing Software



- ▶ To prepare a 3D file for printing
- ▶ Generates a gcode
- ▶ Free & open source on [GitHub](#)
- ▶ Easy to use user interface
- ▶ Prepares printing files up to 20 micron
- ▶ Creates support structures
- ▶ Multiple industry-standard files STL / OBJ / DAE / AMF



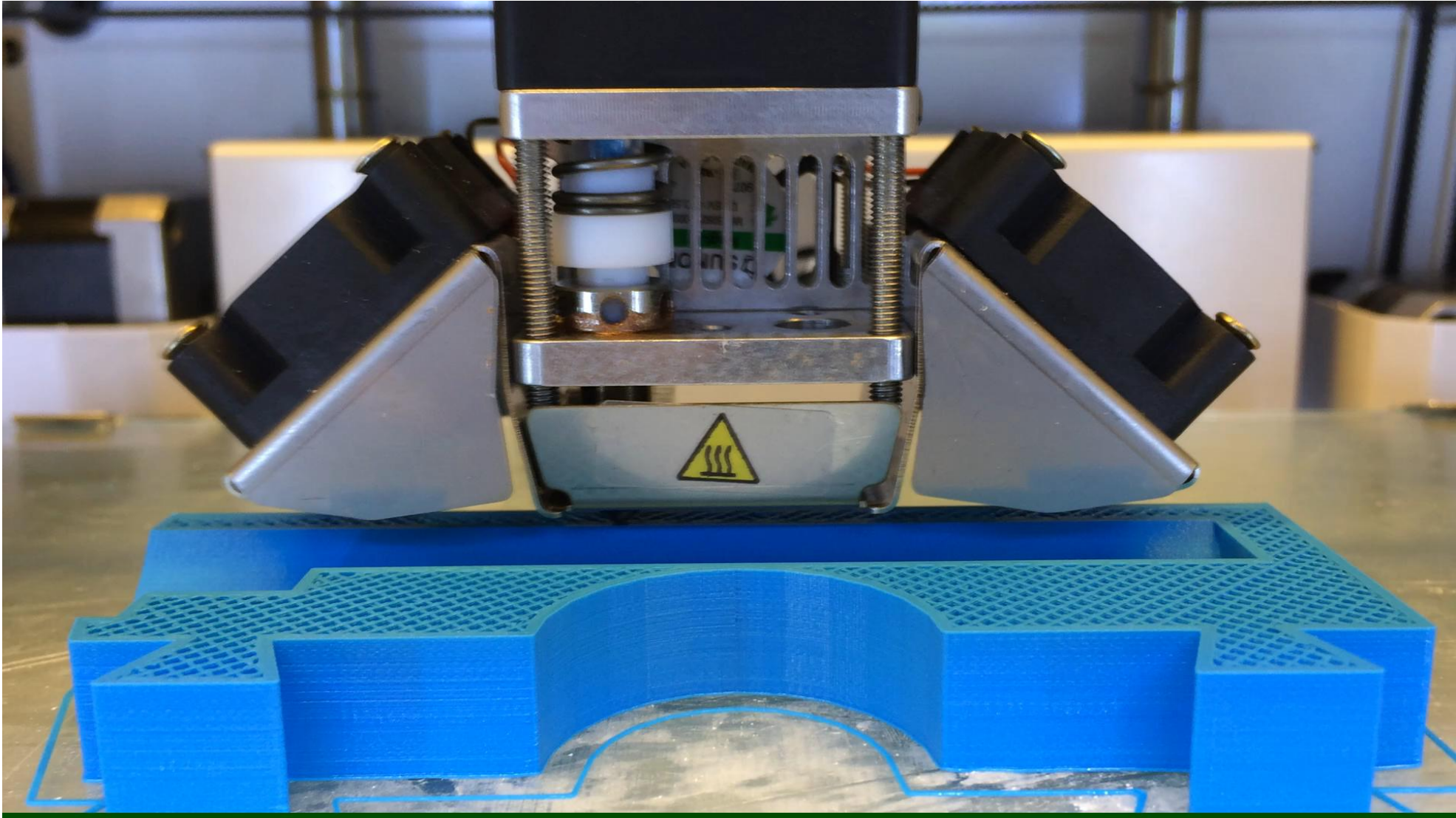
Slicing

The screenshot displays the Cura 14.01 software interface. On the left, the 'Advanced' settings panel is open, showing the following configurations:

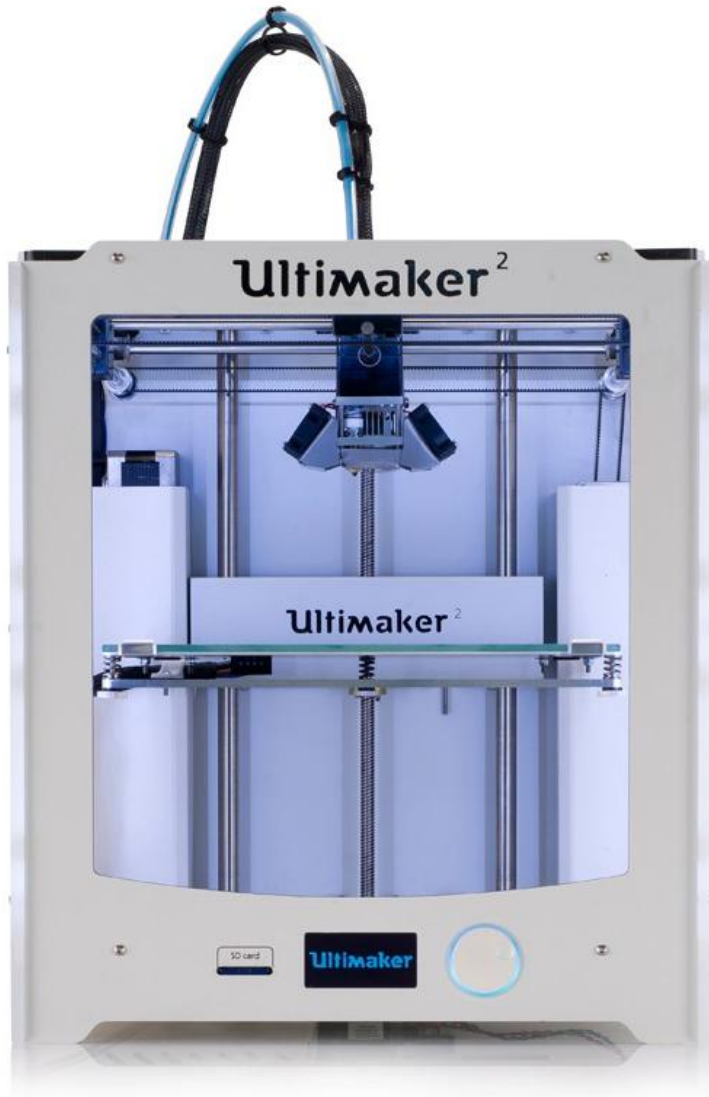
- Quality:** Layer height (mm) is 0.1, Shell thickness (mm) is 0.8, and Enable retraction is checked.
- Fill:** Bottom/Top thickness (mm) is 1, and Fill Density (%) is 10.
- Speed and Temperature:** Print speed (mm/s) is 50.
- Support:** Support type and Platform adhesion type are both set to 'None'.

The main 3D view shows a blue checkered plate being sliced on a printer bed. The printer is labeled 'Ultimaker²'. Above the model, the estimated print statistics are displayed: 8 hours 8 minutes, 7.06 meter, and 56 gram. The interface includes a menu bar (File, Tools, Machine, Expert, Help) and a toolbar with icons for printing, saving to SD, and a 'YM' logo. The Windows taskbar at the bottom shows the time as 21:36 on 22.03.2014.

Fused Deposition Modeling (FDM)



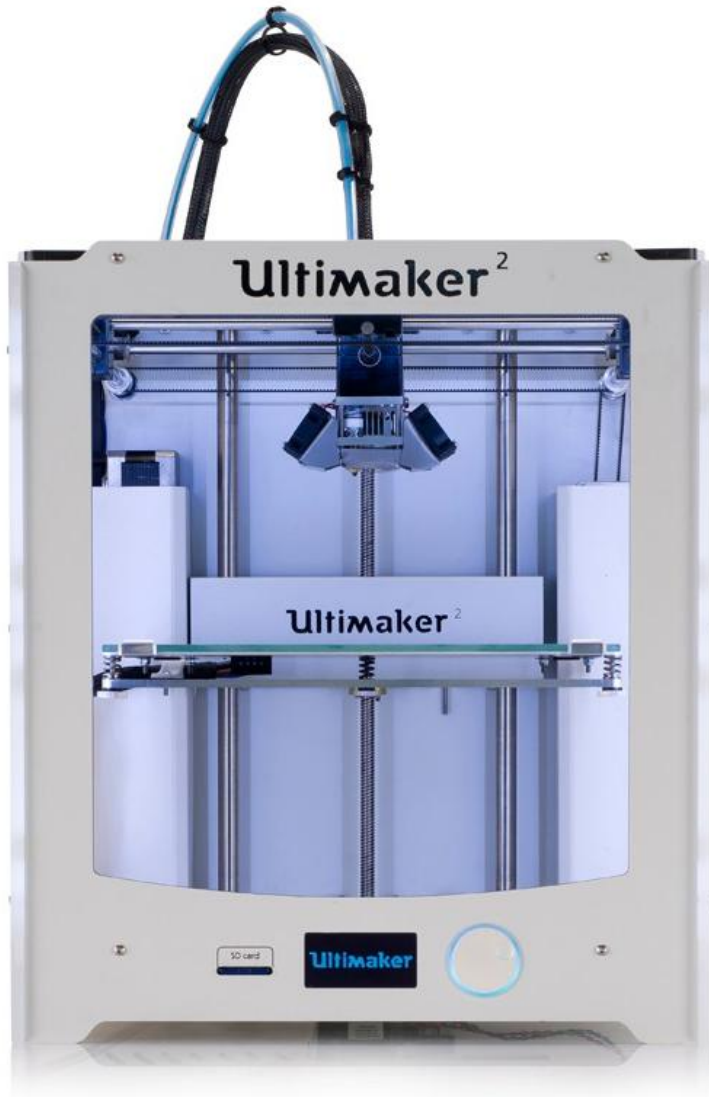
Ultimaker FDM-Printer



- ▶ Layer resolution: up to 10 micron
- ▶ Build volume: 23 x 22.5 x 20.5 cm
- ▶ Print speed: 30 mm/s - 300 mm/s
- ▶ Travel speed: 30 mm/s - 350 mm/s
- ▶ Nozzle diameter: 0.4 mm
- ▶ Operation heated bed temperature: 50° - 100° C
- ▶ AC input: 100 - 240 V / ~4 AMPS / 50 - 60 HZ / 221 watt max. Power requirements: 24 V DC @ 9.2 AMPS
- ▶ Usage cost: ~ €0.05 / cm³ (material and power)
- ▶ Stand-alone SD-card printing
- ▶ WiFi printing ready (future upgradeable)
- ▶ Software: Cura Slice Software

- ▶ Price: € 1895
 \$ 2600
 NIS 9100

Ultimaker FDM-Printer



- ▶ Layer resolution: up to 20 micron
 - ▶ Build volume: 23 x 22.5 x 20.5 cm
 - ▶ Position precision X Y Z: 12.5 / 12.5 / 5 micron
 - ▶ Print speed: 30 mm/s - 300 mm/s
 - ▶ Travel speed: 30 mm/s - 350 mm/s
 - ▶ Recommended filament diameter: 2.85 mm
 - ▶ Nozzle diameter: 0.4 mm
 - ▶ Stand-alone SD-card printing
 - ▶ WiFi printing ready (future upgradeable)
 - ▶ Software: Cura Slice Software
-
- ▶ Price: € 1895
 \$ 2600
 NIS 9100

Ultimaker Material



PLA:

- ▶ Poly-Lactic-Acid, a biodegradable polymer that has a low melting point
- ▶ produced from lactic acid, which can be fermented from crops such as maize
- ▶ harder than PTFE and melts at a lower temperature (around 180°C to 220°C)
- ▶ 0.75kg with 2.85mm diameter and approximately 90m long
- ▶ Cost: € 31,50 / \$ 43,50

Ultimaker Material



ABS:

- ▶ Acrylonitrile Butadiene Styrene (ABS)
- ▶ better mechanical properties than HDPE
- ▶ less brittle than PLA
- ▶ handles higher temperatures
- ▶ One of the most common plastics
- ▶ 230°C is the standard for printing
- ▶ Cost: € 31,50 / \$ 43,50

Where can I get the models from?
... Thingiverse

Thingiverse

- ▶ Design community for discovering, making, and sharing 3D printable things
- ▶ world's largest 3D printing community
- ▶ open platform:
>> make share discover <<
- ▶ 100,000 free 3D models
- ▶ www.thingiverse.com

MakerBot Thingiverse DASHBOARD EXPLORE CREATE SIGN IN / JOIN







Thingiverse Featured

Create over a 100 convex polyhedra with regular faces (except for prisms and anti-prisms) with the [Customizable Convex Polyhedra](#). This includes the Platonic, Archimedean, and Johnson polyhedra.

[Learn More](#)






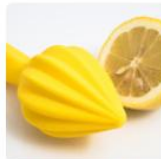


Global Feed

Latest Thingiverse Activity

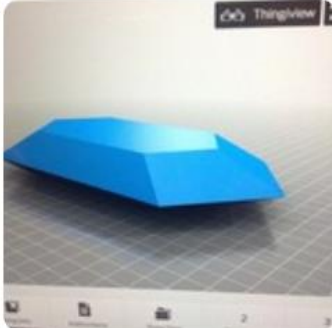
-  krizzap made a copy of FSR Mount for 170 and 190 d...
-  scheerny liked Lollipop
-  jaabanco started using Customizer
-  TheSeend started using Customizer
-  AndyP liked Leonardo da Vinci's self-supporti...
-  TheSeend started using Customizer


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There will be products that are only possible to produce
by generative to manufacturing.

Thank you for your attention.
... Questions?

Source

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Source

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