

Cipher Automotive – Startup Finder

LIDAR TECHNOLOGY



Cipher - Startup Finder

Unique analysis for buy/build decisions

- ▶ Cipher Automotive's Startup Finder provides unique ways to identify small companies, universities, collaborations and non-automotive companies working **within any automotive technology**
- ▶ This report focuses on **Lidar technology** and analyses patents published 2010 to 2018 globally
- ▶ Patent data provides a unique dataset and insights to uncover LiDAR capabilities or initiatives at companies that are not yet public or known to the general public or from non-English speaking countries
- ▶ Data is cleaned and curated by Cipher team, all identified companies have been vetted and complemented with links
- ▶ Seamless integration for your with other datasets and further analysis!



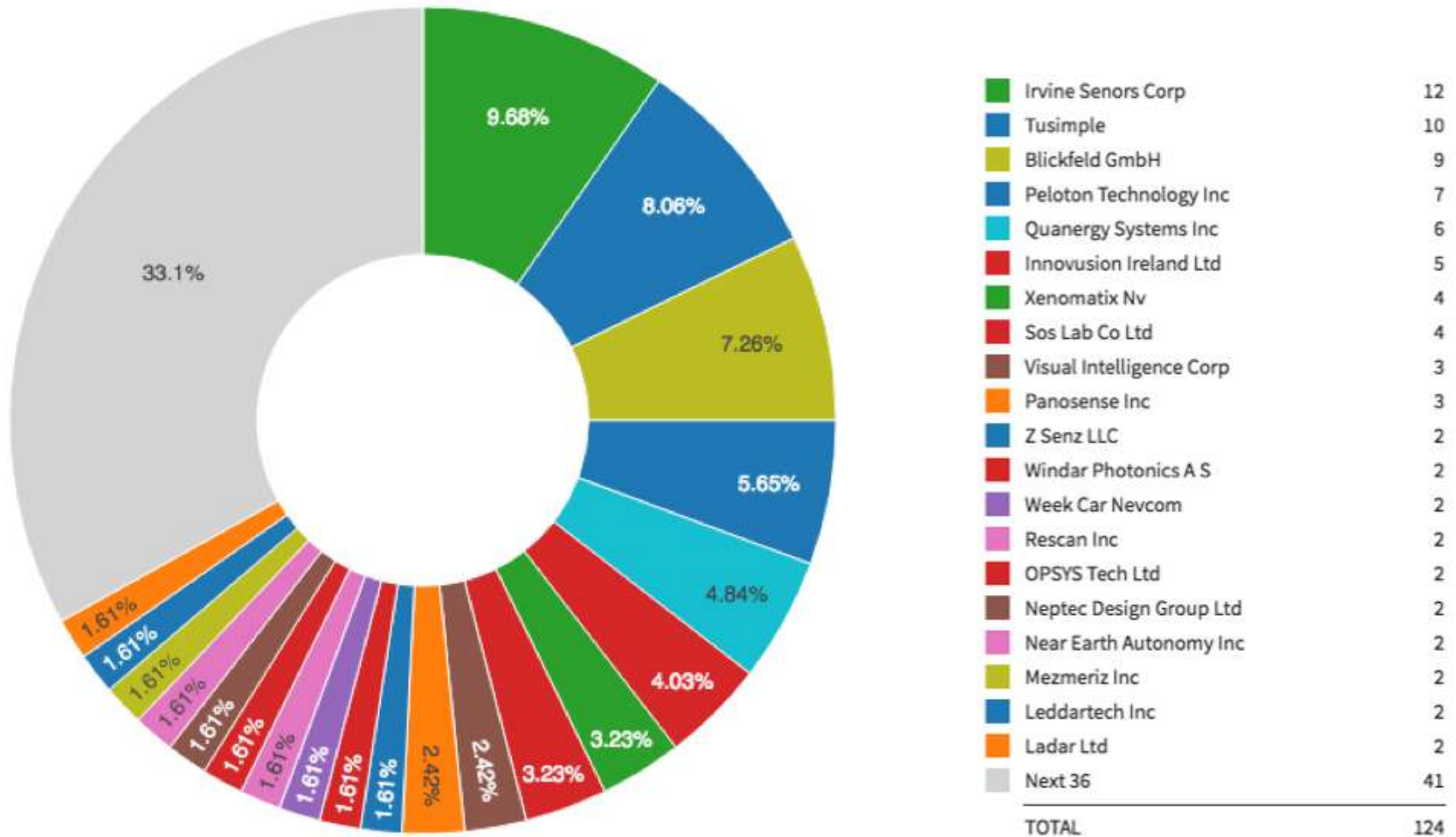
Lidar Technology Landscape

- ▶ Companies outside “typical” OEMs and Tier 1 suppliers have been identified as actively patenting Lidar Technology.
- ▶ **56 “startups” identified** within 19 different sub-technologies
- ▶ Additional **82 organisations, outside the main Automotive OEMs and Tier1 suppliers**, were identified
- ▶ **63 Industry Collaborations** were identified
- ▶ Summary in the following pages accompanied with live, dynamic Cipher Automotive reports
- ▶ All organisations have at least one published Lidar patent. Most organisations have current Lidar offerings, for others (especially larger organisations) this can be evidence of future plans / product launches
- ▶ Live Cipher reports give access to full patent data and detail for Cipher Subscribers and Project Clients



Startups – Overview

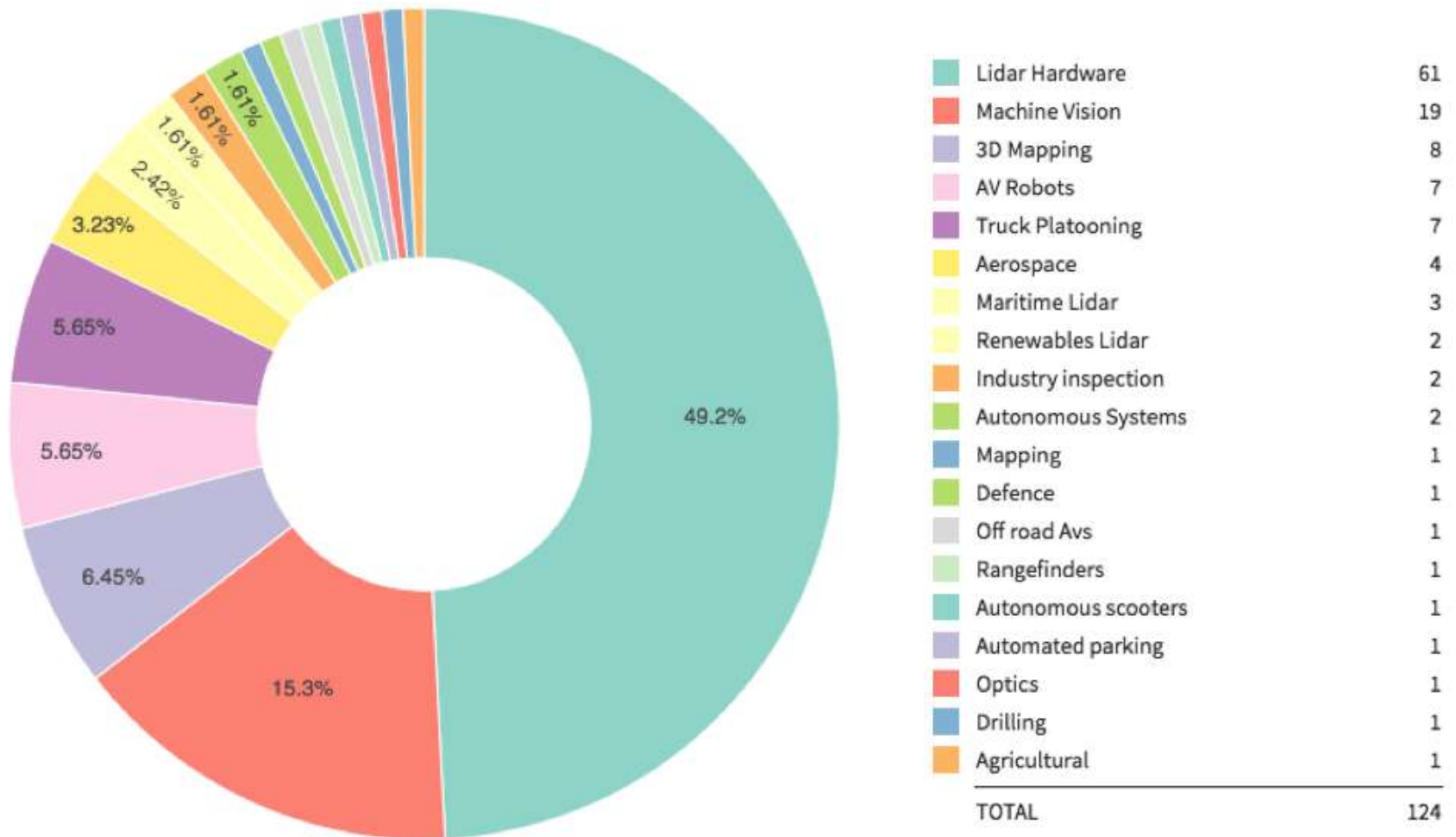
Lidar Startup overview – active patents owned by each startup



https://app.cipher.ai/report/436aae967f/ACTIVE_FAMILIES_BY_PORTFOLIO_ID

Startups – Sub Technology Overview

Lidar Startup sub-technology overview – active patents per sub-technology



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Startups – 1 of 3

# Lidar Patents	LIDAR Concentration (% of tot. patents)	Organisation Name	Sub technology	Link
2	66.7%	3d Laser Mapping Ltd	3D Mapping	https://www.3dlasermapping.com/
1	10.0%	Naver Labs Co., Ltd.	3D Mapping	https://www.naverlabs.com/en/
2	50.0%	Rescan Inc	3D Mapping	http://www.rescan360.com/
1	25.0%	Tetravue Inc	3D Mapping	https://www.tetravue.com/
3	30.0%	Visual Intelligence Corp	3D Mapping	https://visualintelligenceinc.com/
2	40.0%	Near Earth Autonomy Inc	Aerospace	https://www.nearearth.aero/technology
2	33.3%	Neptec Design Group Ltd	Aerospace	https://neptec.com/
1	50.0%	Crinklawn Farm Services Inc	Agricultural	http://crinklawnfarmservice.com/
1	20.0%	Frogparking Ltd	Automated parking	https://frogparking.com/
1	7.7%	Lit Motors Corp	Autonomous scooters	http://litmotors.com/c-1/
2	8.7%	Argo Ai LLC	Autonomous Systems	https://www.argo.ai/our-mission/
1	100.0%	Robotwits LLC	Autonomous Systems	http://www.robotwits.com/
1	50.0%	Thordrive Co Ltd	Autonomous Systems	https://www.thordrive.ai/
2	40.0%	BALYO	AV Robots	https://www.balyo.us/Technology
1	50.0%	BOT3 Inc	AV Robots	http://www.bot3-usa.com/
1	5.3%	Clearpath Robotics Inc	AV Robots	https://www.clearpathrobotics.com/
1	100.0%	DOXEL Inc	AV Robots	https://www.doxel.ai/
1	20.0%	Effidence	AV Robots	https://www.effidence.com/
1	6.3%	Seegrid Operating Corp	AV Robots	https://seegrid.com/platform/

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Startups – 2 of 3

# Lidar Patents	LIDAR Concentration (% of tot. patents)	Organisation Name	Sub technology	Link
1	12.5%	Stratom Inc	Defence	http://www.stratom.com/Technologies.html
1	14.3%	Drilling Technological Innovations	Drilling	https://www.dtilc.com/
1	6.3%	Sharper Shape OY	Industry inspection	https://sharpershape.com/
1	5.6%	Ulc Robotics Inc	Industry inspection	http://ulcrobotics.com/
2	25.0%	AEYE Inc	Lidar Hardware	https://www.aeye.ai/
2	40.0%	Agerpoint Inc	Lidar Hardware	https://www.agerpoint.com/
9	60.0%	Blickfeld GmbH	Lidar Hardware	https://www.blickfeld.com/
2	100.0%	Cepton Technologies Inc	Lidar Hardware	https://www.cepton.com/
5	83.3%	Innovusion Ireland Ltd	Lidar Hardware	https://www.innovusion.com/
16	40.0%	Irvine Senors Corp	Lidar Hardware	https://www.irvine-sensors.com/products
2	10.5%	Leddartech Inc	Lidar Hardware	https://leddartech.com/
2	28.6%	Mezmeriz Inc	Lidar Hardware	https://mezmeriz.com/
2	100.0%	OPSYS Tech Ltd	Lidar Hardware	https://www.opsys-tech.com/lidar
6	60.0%	Quanergy Systems Inc	Lidar Hardware	https://quanergy.com/
1	50.0%	Red Sensors Ltd	Lidar Hardware	https://redsensors.uk/
4	100.0%	Sos Lab Co Ltd	Lidar Hardware	http://soslab.co/en/home-en/
1	100.0%	Viametris SAS	Lidar Hardware	https://www.viametris.com/
2	18.2%	Week Car Nevcom	Lidar Hardware	http://www.carnavi.com/
5	41.7%	Xenomatrix Nv	Lidar Hardware	http://www.xenomatrix.com/
1	100.0%	Yado Holding BV	Lidar Hardware	http://yadovr.com/
2	100.0%	Z Senz LLC	Lidar Hardware	http://www.z-senz.com/

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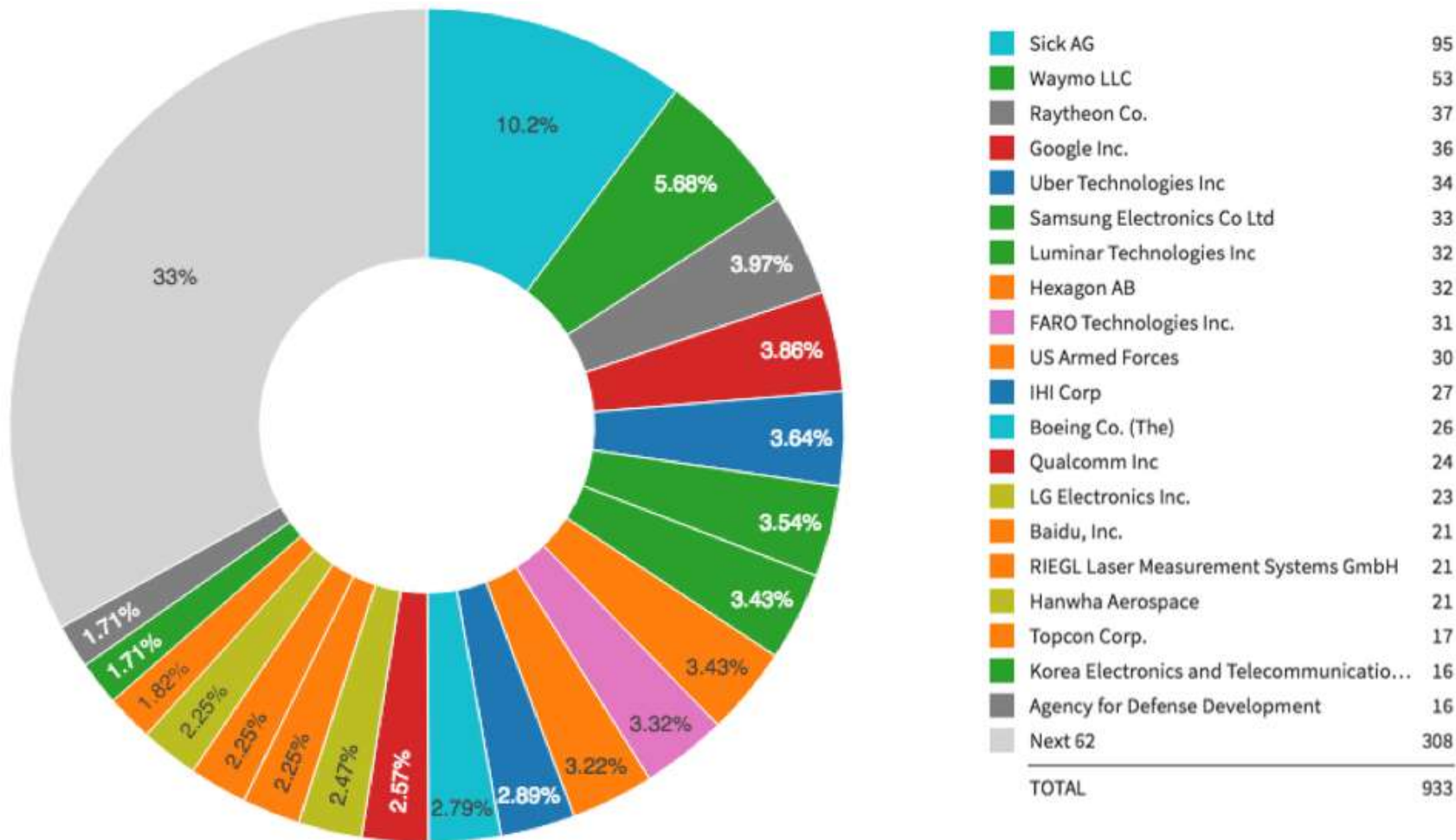
Startups – 3 of 3

# Lidar Patents	LIDAR Concentration (% of tot. patents)	Organisation Name	Sub technology	Link
2	28.6%	4sense Inc	Machine Vision	https://www.4sense.com/
2	100.0%	Deepscale Inc	Machine Vision	http://deepscale.ai/product/
1	33.3%	Dibotics	Machine Vision	http://www.dibotics.com/
1	16.7%	Ekin Teknoloji	Machine Vision	https://www.ekin.com/en/products/
1	33.3%	Fastree3D S A	Machine Vision	https://fastree3d.com/
1	50.0%	Objectvideo Labs LLC	Machine Vision	https://objectvideolabs.com/
10	41.7%	Tusimple	Machine Vision	http://www.tusimple.com/core-en.html
1	33.3%	Vayavision Ltd	Machine Vision	https://vayavision.com/
1	33.3%	Ushr Inc	Mapping	https://www.ushrauto.com/
1	100.0%	Flidar	Maritime Lidar	http://axystechnologies.com/products/flidar-windsentinel/
2	100.0%	Ladar Ltd	Maritime Lidar	https://ladar.co.uk/
1	100.0%	SF Motors Inc	OEM	https://sfmotors.com/contact/
1	33.3%	Rakkatec OY	Off road Avs	http://rakkatec.fi/
1	100.0%	Ffoptik GmbH	Optics	http://www.foptik.com/#technology
1	25.0%	Opti Logic Corp	Rangefinders	http://www.opti-logic.com/
1	50.0%	Windar Photonics A S	Renewables Lidar	http://www.windarphotonics.com/
7	41.2%	Peloton Technology Inc	Truck Platooning	https://peloton-tech.com/

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Non-Automotive Organisations – Overview

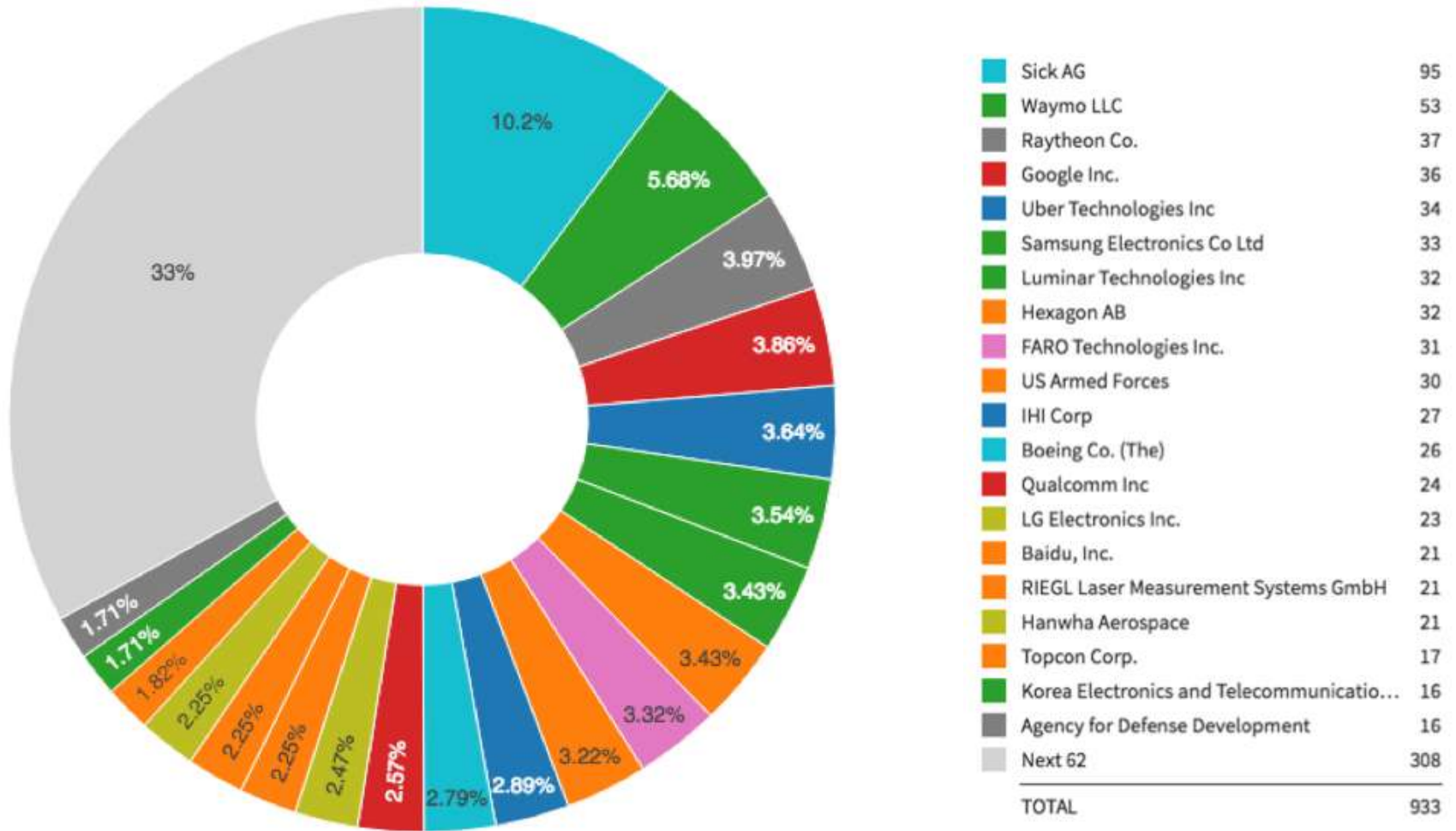
Lidar Non-Automotive overview – active patents per company



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Non-Automotive Organisations – Overview Per Organisation Type

Lidar Non-Automotive overview – active patents per organization type



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Non-Automotive Organisations – 1 of 4

# Lidar Patents	LIDAR Concentration (% of tot. patents)	Organisation Name	Organisation Type
1	0.7%	AeroVironment Inc	Aerospace
15	0.1%	Airbus Group SAS	Aerospace
12	0.1%	BAE Systems Plc.	Aerospace
26	0.1%	Boeing Co. (The)	Aerospace
3	0.1%	DJI	Aerospace
21	0.3%	Hanwha Aerospace	Aerospace
14	0.1%	Lockheed Martin Corp	Aerospace
38	0.2%	Raytheon Co.	Aerospace
10	0.0%	United Technologies Corp	Aerospace
8	0.2%	AGCO Corp.	Agricultural
7	0.1%	Deere & Co.	Agricultural
33	1.8%	Hexagon AB	Components
39	0.1%	IHI Corp	Components
114	4.5%	Sick AG	Components
7	0.0%	STMicroelectronics	Components
4	0.2%	Ball Corporation	Industrial
32	9.4%	FARO Technologies Inc.	Industrial
3	1.6%	Pepperl Fuchs GmbH	Industrial
2	2.2%	Ambarella Inc	Lidar Specialised
4	50.0%	Innoviz Technologies Ltd	Lidar Specialised
1	25.0%	Leosphere	Lidar Specialised
32	88.9%	Luminar Technologies Inc	Lidar Specialised
22	26.5%	RIEGL Laser Measurement Systems GmbH	Lidar Specialised
12	33.3%	StereoVision Imaging Inc	Lidar Specialised
15	93.8%	Velodyne Lidar Inc	Lidar Specialised

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Non-Automotive Organisations – 2 of 4

# Lidar Patents	LIDAR Concentration (% of tot. patents)	Organisation Name	Organisation Type
1	0.03%	Didi	Mobility
1	100.0%	Navya	Mobility
34	6.7%	Uber Technologies Inc	Mobility
53	29.3%	Waymo LLC	Mobility
12	28.6%	ZOOX Inc	Mobility
10	3.5%	Faraday & Future Inc	OEM
12	0.3%	Jenoptik AG	Optics
17	0.3%	Topcon Corp.	Optics
18	0.4%	Agency for Defense Development	Research
2	0.5%	Automotive Research & Testing Center (ARTC)	Research
2	0.2%	Carnegie Mellon University	Research
3	0.4%	Centre Nat Etd Spatiales	Research
2	0.0%	Commissariat A L'Energie Atomique	Research
5	0.1%	Commonwealth Scientific and Industrial Research Organization	Research
1	0.1%	Consiglio Nazionale Delle Ricerche (CNR)	Research
1	0.6%	Daegu Gyeongbuk Inst Science and Tech	Research
3	0.2%	Daegu Gyeongbuk Institute Of Science & Technology	Research
1	0.1%	Dankook University Industry-Academia Collaboration Foundation	research
1	0.8%	Florida Atlantic University	research
1	0.2%	Freiburg University	research
5	0.1%	German Aerospace Center (Research
5	0.1%	INHA University	Research
3	0.2%	International Electro-Communications Communication Foundation	Research
3	1.1%	International Electronics & Engineering S.A. (IEE)	Research
18	0.0%	Korea Electronics and Telecommunications Research Institute	Research

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Non-Automotive Organisations – 3 of 4

# Lidar Patents	LIDAR Concentration (% of tot. patents)	Organisation Name	Organisation Type
11	0.2%	Korea Electronics Technology Institute	Research
5	0.1%	Massachusetts Institute of Technology	Research
2	40.0%	Nova Dynamics LLC	Research
1	100.0%	Novateur Research Solutions LLC	Research
5	0.5%	Southwest Research Institute	Research
2	0.3%	Universitat Politecnica De Catalunya	Research
2	0.2%	University of Central Florida	Research
3	0.2%	University of Colorado	Research
3	0.0%	University of Minnesota (The Regents Of)	Research
33	0.1%	US Armed Forces	Research
3	1.0%	Utah State University	Research
7	2.1%	Irobot Corp	Robotics
2	1.4%	Yujin Robot Co Ltd	Robotics
1	4.8%	Analog Modules Inc	Sensors
5	0.6%	Flir Systems AB	Sensors
2	0.0%	Amazon.com Inc.	Tech
12	0.1%	Apple Inc	Tech
21	0.2%	Baidu, Inc.	Tech
3	0.0%	Cisco Systems Inc.	Tech
16	0.0%	Fujitsu Limited	Tech
36	0.1%	Google Inc.	Tech

https://app.cipher.ai/report/431e17166a/ACTIVE_FAMILIES_BY_PORTFOLIO_ID

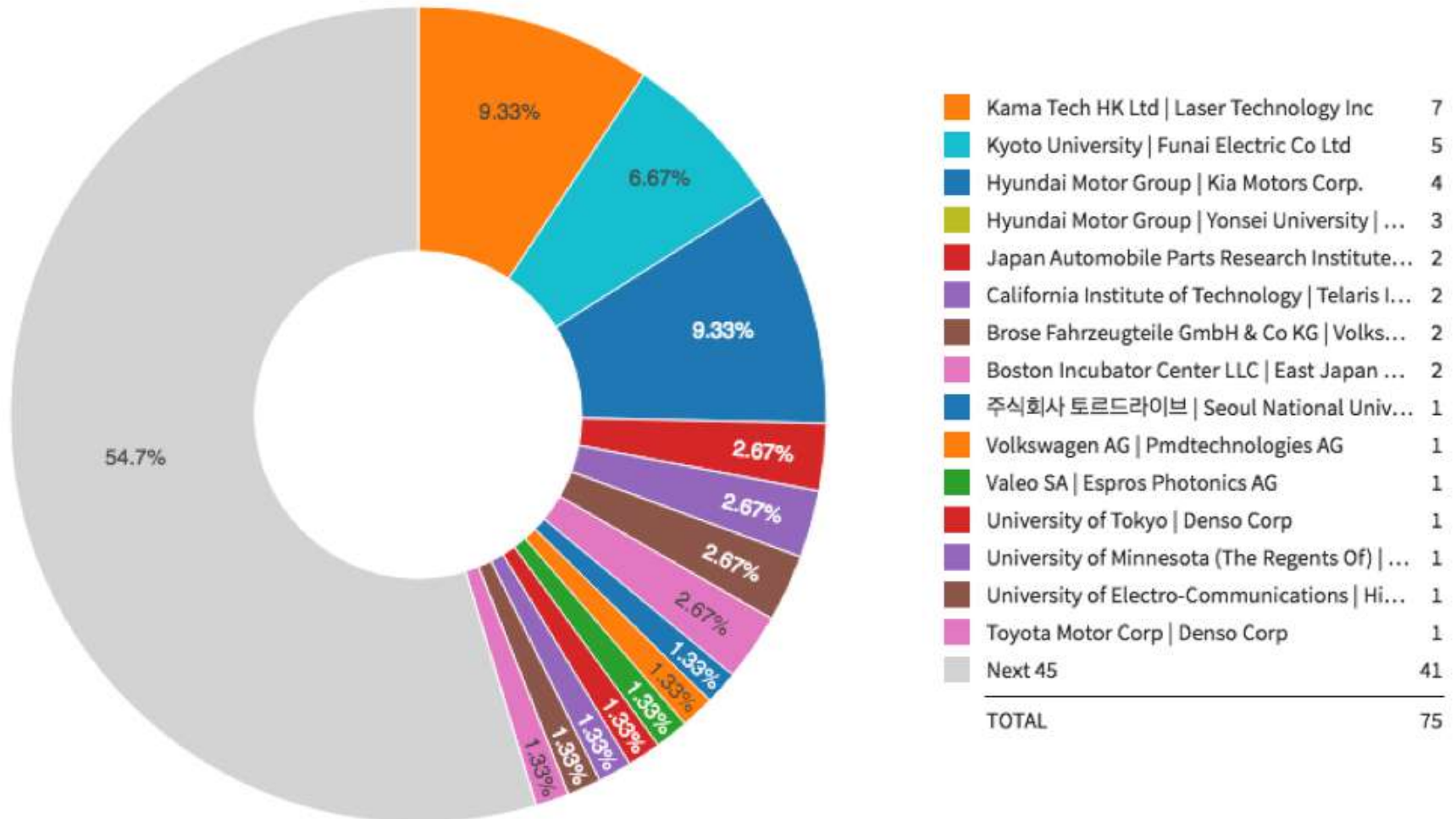
Non-Automotive Organisations – 4 of 4

# Lidar Patents	LIDAR Concentration (% of tot. patents)	Organisation Name	Organisation Type
10	0.0%	Intel Corporation	Tech
6	0.0%	International Business Machines Corp	Tech
24	0.0%	LG Electronics Inc.	Tech
8	0.0%	Microsoft Corporation	Tech
22	0.0%	Panasonic Corporation	Tech
24	0.1%	Qualcomm Inc	Tech
33	0.0%	Samsung Electronics Co Ltd	Tech
2	0.1%	Walt Disney Co.	Tech
5	1.3%	X Development Llc	Tech

https://app.cipher.ai/report/431e17166a/ACTIVE_FAMILIES_BY_PORTFOLIO_ID

Lidar Collaborations – Overview

Lidar Research Collaborations overview – number of active co-owned patents



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Lidar Collaborations – 1 of 3

# Total Co-owned patents	Organisation 1	Organisation 2	Organisation 3	Timeline of patent publications									
				2010	2011	2012	2013	2014	2015	2016	2017	2018	
2	Airbus Group SAS	Centre Nat Etd Spatiales		0	2	0	0	0	0	0	0	0	0
2	Alt KK	IHI Corp		0	2	0	0	0	0	0	0	0	0
2	ASIAtec Co., Ltd.	Korea Electronics and Telecommunications Research Institute		0	0	0	0	0	2	0	0	0	0
2	Beijing Aerospace Institute for Metrology and Measurement Tech	China Academy of Launch Vehicle Tech		0	0	0	0	0	0	0	2	0	0
4	Boston Incubator Center LLC	East Japan Railway Company		0	0	0	0	0	0	0	0	0	4
4	Brose Fahrzeugteile GmbH & Co KG	Volkswagen AG		0	0	0	2	2	0	0	0	0	0
4	California Institute of Technology	Telaris Inc		0	0	0	2	2	0	0	0	0	0
2	Catholic Kwandong University Industry Foundation	Main jit		0	0	0	0	0	2	0	0	0	0
2	Central Florida Expressway Authority	University of Central Florida		0	0	0	0	0	0	0	0	0	2
2	Chongqing Jinkang New Energy Vehicle Co Ltd	SF Motors Inc		0	0	0	0	0	0	0	0	0	2
2	Consiglio Nazionale Delle Ricerche (CNR)	CNISM Consorzio Nazionale Interuniversitario Per Le Scienze Fisiche Della Materia		2	0	0	0	0	0	0	0	0	0
2	Crane Co.	Virginia Tech University		0	0	0	0	2	0	0	0	0	0
2	Doshisha	Denso Corp		0	0	2	0	0	0	0	0	0	0
2	East Nippon Expressway Co Ltd	Hokuyo Automatic Co		0	0	0	0	0	0	2	0	0	0
2	Ford Motor Co	ThyssenKrupp		0	0	0	0	0	0	0	2	0	0
2	Freiburg University	PI Micos GmbH		0	0	2	0	0	0	0	0	0	0
2	General Motors Co (GM)	Carnegie Mellon University		2	0	0	0	0	0	0	0	0	0
2	Hamamatsu Photonics KK	Nippon Signal Co Ltdthe		0	0	0	0	0	0	0	2	0	0
2	Hamburg Innovation GmbH	Helmut Schmidt Universität		0	0	0	0	0	0	2	0	0	0
2	Hokuyo Automatic Co	Toyota Motor Corp		0	2	0	0	0	0	0	0	0	0
10	Hyundai Motor Group	Kia Motors Corp.		0	0	2	0	0	0	0	0	0	8
3	Hyundai Motor Group	Konkuk University	Kia Motors Corp.	0	0	0	0	0	0	0	0	0	3

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Lidar Collaborations – 2 of 3

# Total Co-owned patents	Organisation 1	Organisation 2	Organisation 3	Timeline of patent publications									
				2010	2011	2012	2013	2014	2015	2016	2017	2018	
9	Hyundai Motor Group	Yonsei University	Kia Motors Corp.	0	0	0	0	0	6	3	0	0	
2	IMU Korea	Myongji Univ Industry and Academia Cooperation Foundation		0	0	0	0	0	0	0	0	2	
2	In the Life KK	Harada Electronics Ind		0	0	0	0	0	0	0	2	0	
2	Ingenieurbüro Spies Gbr	Volkswagen AG		0	0	2	0	0	0	0	0	0	
2	Isa Industrieelektronik GmbH	German Aerospace Center (Deutsches Zentrum für Luft-und Raumfahrt)		2	0	0	0	0	0	0	0	0	
6	Japan Automobile Parts Research Institute	Denso Corp		2	2	0	0	2	0	0	0	0	
2	Kajima Corp	National Institute of Advanced Industrial Science and Technology		2	0	0	0	0	0	0	0	0	
14	Kama Tech HK Ltd	Laser Technology Inc		0	0	0	2	4	0	4	2	2	
2	Kobe University	NOHMI Bosai Ltd		0	0	0	0	0	0	0	2	0	
10	Kyoto University	Funai Electric Co Ltd		0	0	0	0	0	0	10	0	0	
2	Kyung Hee University	LIG Nex1 Co Ltd		0	0	0	0	0	0	0	0	2	
2	Landor Arch Inc	Seoul National Univ R and Db Foundation		0	0	0	0	0	0	0	0	2	
2	Latecoere	Office National D Etudes Et Recherches Aérospatiales		0	0	0	0	0	0	0	2	0	
2	Lockheed Martin Corp	Flir Systems AB		0	0	0	2	0	0	0	0	0	
2	Malaviya National Institute of Technology	Malaviya Nat Inst of Technology		0	0	0	0	0	2	0	0	0	
2	MAN SE	Volkswagen AG		0	0	0	0	0	0	0	0	2	
3	Montana State University	US Armed Forces	University Corp for Atmospheric Research	0	0	0	0	0	0	0	3	0	
2	Nagoya Institute of Technology	Denso Corp		0	0	0	0	0	0	2	0	0	
2	Netherlands Organization for Applied Scientific Research TNO	Koninklijke Kpn Nv		0	0	0	0	0	0	0	2	0	
2	Odakyu Eng Co Ltd	Nachuru KK		0	0	0	0	0	0	2	0	0	
2	Osaka University	Toyota Motor Corp		0	2	0	0	0	0	0	0	0	
2	Robotwits LLC	Denso Corp		0	0	0	0	0	0	0	0	2	

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Lidar Collaborations – 3 of 3

# Total Co-owned patents	Organisation 1	Organisation 2	Organisation 3	Timeline of patent publications									
				2010	2011	2012	2013	2014	2015	2016	2017	2018	
2	Ryoden Shonan Electronics Corp	Mitsubishi Electric Corp		0	0	0	0	0	0	0	0	0	2
2	Samsung Electronics Co Ltd	Hansung Weltech Co.		0	0	0	0	0	0	2	0	0	0
2	Seoul National University	Thordrive Co Ltd		0	0	0	0	0	0	0	2	0	0
2	SK Telecom Co. Ltd.	Korea Electronics and Telecommunications Research Institute		0	2	0	0	0	0	0	0	0	0
2	SL Seobong Corp	SL Corp		0	0	0	0	2	0	0	0	0	0
2	State Dongyang Chemical	Dongyang Hi-Tech Industrial Co., Ltd.		0	0	0	0	2	0	0	0	0	0
3	Studios Macrograph Inc	Agaworld Co Ltd	Dascon Media Group	0	0	0	0	0	0	0	0	0	3
2	Sunchon National University Industry-Academic Cooperation Foundation	Quesais		0	0	0	2	0	0	0	0	0	0
2	Suwon University Industry Collaboration Foundation	WI A Corp		0	0	0	2	0	0	0	0	0	0
2	The Industry and Academic Cooperation In Chungnam National University Iac	Hyundai Mobis Co Ltd		0	0	0	0	0	0	2	0	0	0
2	ThorDrive	Seoul National University		0	0	0	0	0	0	0	2	0	0
2	Toshiba Corp	Toshiba Infrastructure Systems Co., Ltd.		0	0	0	0	0	0	0	0	2	0
2	Toyota Motor Corp	Denso Corp		0	0	0	0	0	0	0	0	2	0
2	University of Electro-Communications	Hino Motors Ltd		0	0	0	0	0	2	0	0	0	0
2	University of Minnesota (The Regents Of)	Toyota Motor Corp		0	0	0	0	0	0	0	0	2	0
2	University of Tokyo	Denso Corp		0	0	0	0	2	0	0	0	0	0
2	Valeo SA	Espros Photonics AG		0	0	0	0	0	0	0	0	2	0
2	Volkswagen AG	Pmdtechnologies AG		0	0	0	2	0	0	0	0	0	0

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Report methodology

- ▶ Cipher Automotive’s state of the art AI powered patent categorization was used to identify relevant patents.
- ▶ Our definition of Lidar:
 - ▶ “Lidar/ladar (Light Detection And Ranging/Light Imaging, Detection, And Ranging) sensors are a type of electronic instrument that use light pulses as a medium to survey the environment. Lidar sensor systems contain transmitters, receivers, and image processing capabilities, for the detection, creation and visual illustration of objects, such as pedestrians or obstacles, in the exterior environment of a vehicle. Lidar systems are used independently or in combination with single- or multi-camera systems, and other detection methods. Auxiliary post processing systems may use the sensor’s data to create images or may apply the data to various secondary systems, such as blind spot detection systems, or collision detection systems.”
- ▶ All 7.5 million patent families published 2010 – 2018 globally (excluding patents filed only in China) were analysed
- ▶ All identified organisations were manually checked and vetted by Cipher team and hyperlinks were added for webpages of startups.
- ▶ A “startup” is considered to be a smaller/less known/VC funded company that is typically not considered as one of the main suppliers.
- ▶ A collaboration is considered to have taken place if a patent is co-owned by two or more entities.
- ▶ Online reports area available to Cipher Subscribers and Project Clients
- ▶ All reports and statistics in this report refers to patent families