Study of Intellectual Property on Autonomous and Electric Vehicles

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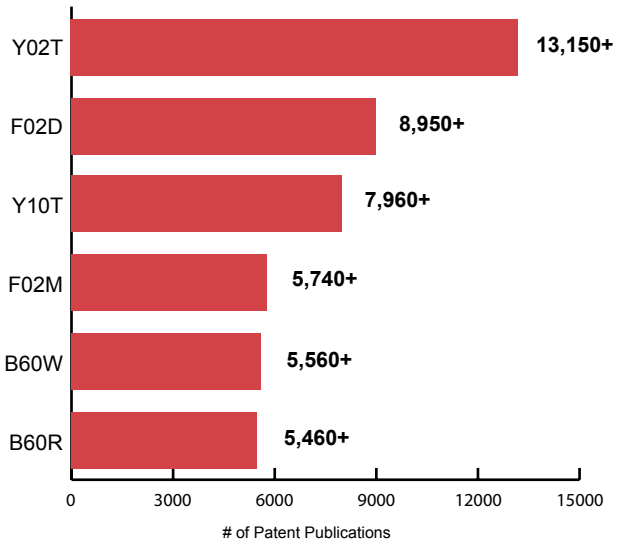
A Look at Ford, Google, and Tesla

There are several technologies new to the automotive industry that will be essential in developing a fully-automated vehicle. Vehicle connectivity, for example, surrounding mobile devices, in-car devices, and other wireless communication systems will be central to the design and efficacy of tomorrow's vehicles. This extends to the safety of autonomous vehicles which will require advanced sensory technologies, detailed navigation software, and complex machine learning capabilities. Any company looking to enter this market will need patented technologies developed in-house, or accessible by other means such as licensing, cross-licenses, or at the very least, patent protection from a third party provider. Patents pertaining specifically to autonomous vehicles are relatively new to the market and will encompass several different technology types. Also, meeting government mandates and consumer demand for battery-powered electric vehicles will be important to car manufacturers.

ktMINE analyzed the patent portfolios of three innovative companies in this space to determine which possessed the necessary technology in order to meet the demands of this industry. ktMINE surveyed Ford, a traditional automotive industry leader, Google, a new entrant, and Tesla, a successful EV manufacturer.

TRADITIONAL AUTOMAKERS IN PLAY

ktMINE first took a look at Ford. At a high level, the top CPC Classifications of Ford's portfolio of patent publications in the last 5 years are:



Y02T	CLIMATE CHANGE MITIGATION TECHNOLOGIES RELATED TO TRANSPORTATION
F02D	CONTROLLING COMBUSTION ENGINES
Y10T	TECHNICAL SUBJECTS COVERED BY FORMER US CLASSIFICATION
F02M	SUPPLYING COMBUSTION ENGINES IN GENERAL, WITH COMBUSTIBLE MIXTURES OR CONSTITUENTS THEREOF
B60W	CONJOINT CONTROL OF VEHICLE SUB-UNITS OF DIFFERENT TYPE OR DIFFERENT FUNCTION
B60R	VEHICLES, VEHICLE FITTINGS, OR VEHICLE PARTS, NOT OTHERWISE PROVIDED FOR

Data aggregated from ktMINE with current owner: Ford Global Tech, Ford Motor CO, Ford Global Technologies LLC

Looking a little closer at the patents related to autonomous vehicles and examining the patent portfolios of the other traditional players in the automotive market (e.g. Volvo, BMW, GM), we found that Ford leads the group in both granted patents and patent applications related to autonomous driving technologies with more than 100 patent publications and applications in the field.

Some of these patents include:

1. TRANSITIONING FROM AUTONOMOUS VEHICLE CONTROL TO DRIVER CONTROL TO RESPONDING TO DRIVER CONTROL

US9150224B2 – Country: UNITED STATES – Published: 10/06/2015 – Family #: 52623823

2. AUTONOMOUS VEHICLE CORNERING MANEUVER

US2016159360A1 – Country: UNITED STATES – Published: 06/09/2016 – Family #: 55974852

3. DETECTING LOW-SPEED CLOSE-RANGE VEHICLE CUT-IN

US2016103212A1 – Country: UNITED STATES – Published: 04/14/2016 – Family #: 55130753

4. FAILURE TOLERANT VEHICLE SPEED

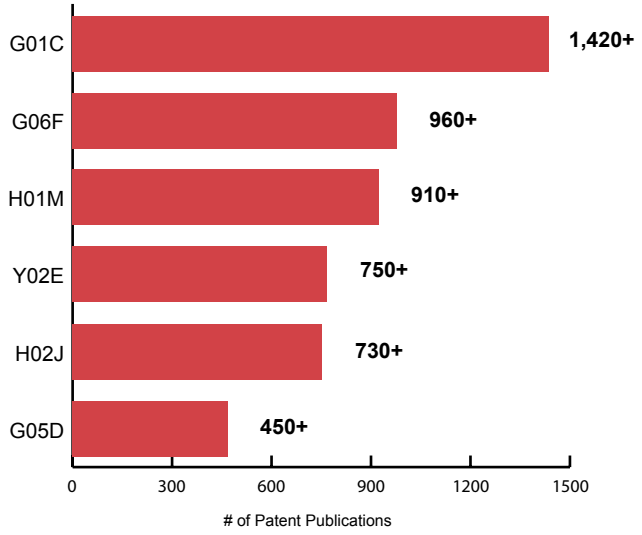
US2016009259A1 – Country: UNITED STATES – Published: 01/14/2016 – Family #: 54013437

Judging by the patent portfolios of several automotive industry leaders, it is clear that not all of the major car manufacturers are focused on filing patents that explicitly refer to autonomous vehicles, at least for now. Both Toyota and Hyundai have fewer than 20 patent publications which mention autonomous vehicles. Volkswagen had the fewest, with just over 10 patent publications pertaining to autonomous vehicles. It could be that many of these companies are looking to partner together to develop the necessary technologies or buy out other entities. ktMINE found that GM has just over 50 patent publications for vehicle automation technologies, yet, considering their recent acquisition of Cruise Automation, a self-driving car startup, it can be speculated that GM plans on using this purchase to bring more patents and expertise in-house.

HIGH-TECH ENTERS THE SPACE

For connectivity and automation innovation, automotive companies will need to turn to high-tech companies in Silicon Valley which have thousands of patents on existing software, A.I., and connectivity technologies central to the future of autonomous cars. In these areas traditional auto companies are far behind.

At a high level, the top CPC Classifications of Google's portfolio of patent publications in this space[1] in the last 5 years are:



G01C	MEASURING DISTANCES, LEVELS OR BEARINGS
G06F	ELECTRICAL DIGITAL DATA PROCESSING
H01M	PROCESSES OR MEANS, E.G. BATTERIES, FOR THE DIRECT CONVERSION OF CHEMICAL INTO ELECTRICAL ENERGY
Y02E	REDUCTION OF GREENHOUSE GASES [GHG] EMISSION, RELATED TO ENERGY GENERATION, TRANSMISSION OR DISTRIBUTION
H02J	CIRCUIT ARRANGEMENTS OR SYSTEMS FOR SUPPLYING OR DISTRIBUTING ELECTRIC POWERNT FUNCTION
G05D	SYSTEMS FOR CONTROLLING OR REGULATING NON-ELECTRIC VARIABLES

1. This data was aggregated from ktMINE with current owners as Google INC & Google Technology Holdings LLC and the following CPC Classifications representing the autonomous and electric vehicle space: B60L, H02J, B60K, Y02T, B60W, B60B, B60Q, B60R, F02D, B60G, B62D, F16H, H01M, Y02E, G01R, Y04S, H02K, B60J, G05B, G01C, B60T, F02B, B60N

ktMINE found that Google was the most innovative in this space by a number of patent applications, with over 200 related patents filed. Some media reports have speculated about a partnership between Google and Ford[1], and from a patent perspective, such a partnership would be strong, with more than 300 patents related to autonomous cars already filed between the two. Google's other patents related to artificial intelligence and machine learning are essential in developing a fully autonomous car. For example, Google has filed patents for:

1. PREDICTIVE REASONING FOR CONTROLLING SPEED OF A VEHICLE

US9381917B1 – Country: UNITED STATES – Published: 07/05/2016 – Family #: 51841907

2. WIDE-VIEW LIDAR WITH AREAS OF SPECIAL ATTENTION

US9383753B1 – Country: UNITED STATES – Published: 07/05/2016 – Family #: 56234878

3. USE OF PRIOR MAPS FOR ESTIMATION OF LANE BOUNDARIES

US2016187887A1 – Country: UNITED STATES – Published: 06/30/2016 – Family #: 55643175

4. ADAPTIVE ALGORITHMS FOR INTERROGATING THE VIEWABLE SCENE OF AN AUTOMOTIVE RADAR

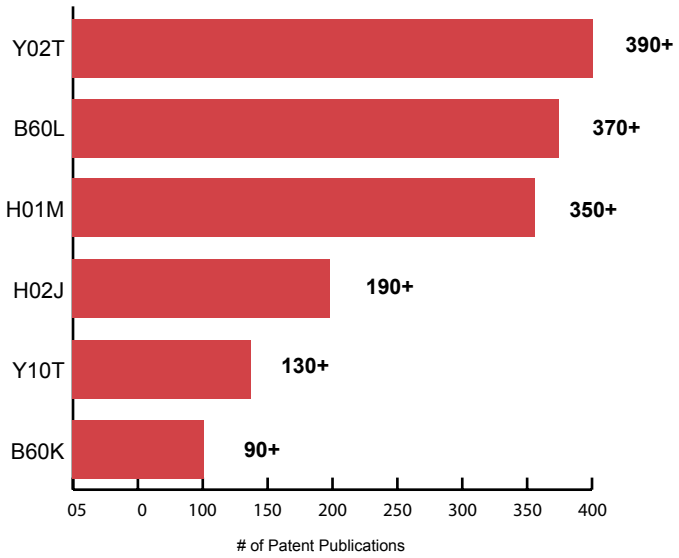
US2016131753A1 – Country: UNITED STATES – Published: 05/12/2016 – Family #: 55912073

EV MANUFACTURERS SEE SUCCESS

Developing more refined methods of powering electric vehicles is important to both the consumer and the government, particularly in the Chinese market. Both strict safety requirements and environmental regulations need to be met in production-level autonomous vehicles. Developing highly efficient vehicles using lithium batteries will push the industry to meet policy requirements. When it comes to overall patent count, Tesla has more than 600 patents filed with the USPTO relating to electric propulsion, proper distribution, and processes of converting chemical energy into electricity.

1 http://www.roadandtrack.com/new-cars/car-technology/news/a27703/ford-google-self-driving-cars/

An overview of Tesla's portfolio of patent publications shows its top CPCclassifications are:



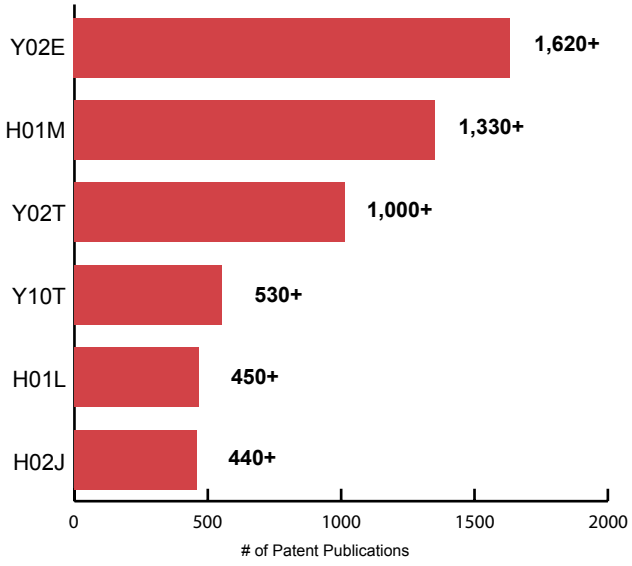
Y02T	CLIMATE CHANGE MITIGATION TECHNOLOGIES RELATED TO TRANSPORTATION
B60L	ELECTRIC EQUIPMENT OR PROPULSION OF ELECTRICALLY-PROPELLED VEHICLES
H01M	PROCESSES OR MEANS, E.G. BATTERIES, FOR THE DIRECT CONVERSION OF CHEMICAL INTO ELECTRICAL ENERGY
H02J	CIRCUIT ARRANGEMENTS OR SYSTEMS FOR SUPPLYING OR DISTRIBUTING ELECTRIC POWER
Y10T	TECHNICAL SUBJECTS COVERED BY FORMER US CLASSIFICATION
B60K	ARRANGEMENT OR MOUNTING OF PROPULSION UNITS OR OF TRANSMISSIONS IN VEHICLES

Data aggregated from ktMINE with current owner: Tesla Motors

Notably, based on a ktMINE search of more than 1,600 patent publications explicitly related to autonomous cars, Tesla doesn't currently claim ownership to any. However, Tesla does have a handful of U.S. patents for measuring relative distance and location, navigation software, and related hardware, which will bolster their capacity to develop autonomous driving and navigation software. Yet, when looking at the total number of patents on autonomous vehicles in development, Tesla trails other market players. Still, Tesla owns desirable electrification technologies that other entities may need to have access to in the future.

EV MANUFACTURERS IN CHINESE MARKET

As the Chinese government mandates a shift towards electrically-powered cars with the help of subsidies, these EV technologies will play a major role in what companies will be successful in the Chinese market. Due to these conditions, Chinese auto companies BYD[1] and Guangzhou Automobile Group Company[2] (GAC) have been very successful. From a patent perspective, these companies fall behind some of their foreign counterparts. ktMINE found that GAC has applied for more than 750 patents with the EPO since 2009, all of which were filed in China. BYD on the other hand has more than 14,000 applications and granted patents in total, with the top patent classifications being:



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Y02T	CLIMATE CHANGE MITIGATION TECHNOLOGIES RELATED TO TRANSPORTATION
Y10T	TECHNICAL SUBJECTS COVERED BY FORMER US CLASSIFICATION
H01L	SEMICONDUCTOR DEVICES
H02J	CIRCUIT ARRANGEMENTS OR SYSTEMS FOR SUPPLYING OR DISTRIBUTING ELECTRIC POWER

Data aggregated from ktMINE with current owner: BYD CO LTD, BYD COMPANY LTD, SHENZHEN BYD AUTO R & D CO LTD, SHENZHEN BYD AUTO R&D COMPANY LTD

These companies have an advantage in China with more access to a growing Asian market, but the Chinese market will be complicated moving forward in the world of autonomous vehicles. The global automation market with be ripe with potential partnerships. Tech companies will look to automotive industry leaders for access to the industry and will, in return, supply connectivity and automation technologies to one day develop fully-automated vehicles. With so many key players, the market will eventually become saturated with patents, and the patent holders or technology developers will need to consolidate in order to survive tough competition.

SUMMARY

Patent infringement litigation is a fear for many in the automotive industry, yet knowing the costs of patent infringement suits and the existence of patent protection networks, like OIN and RPX, which protect companies from patent trolls and other NPE's, may keep infringement lawsuits in check.

ktMINE's analysis found that each of these companies is better equipped with existing patents in each space. Google's patents on wireless communications networks enable the company to develop a fully-connected autonomous vehicle with the latest in 5G mobile connection; other segments of the portfolio, like speech analysis and navigation software, will be technologies expected among future smart cars and will make it tougher for traditional automotive leaders to catch up with Google. In Wireless Communications Networks alone, Google has more than 18,000 patent publications and patent applications. Tesla, however, largely focuses on EV innovation and the latest technologies in electric cars, batteries, and electrical systems. Tesla owns more than 350 patents regarding

1 http://www.forbes.com/sites/mclifford/2016/07/26/with-a-little-help-from-its-friends-lavish-chinese-government-help-for-top-electric-car-maker-byd/#112e66671533
2 http://www.chinadaily.com.cn/business/motoring/2016-04/12/content_24460734.htm

electrical batteries. Beyond that, Tesla continues to build a more efficient EV and owns hundreds of patents on mounting arrangements and vehicle designs for the same. Ford's patent strengths are in safety and vehicle equipment technologies. Ford owns more than 600 patents in traffic control systems and over 1,800 in brake systems alone, which is larger than Tesla's entire portfolio. The size and span of Ford's existing portfolio, along with other automotive industry leaders, should concern newcomers to the auto industry to focus on specializing technologies in development. According to recent news[1], Ford stated that they will have a fully driverless vehicle within five years. As of now, no single entity has the necessary patented technology to put automated cars into production; partnerships will be paramount for success in the global market.

1 http://www.usnews.com/news/business/articles/2016-08-16/ford-says-it-will-have-a-fully-autonomous-car-by-2021

ABOUT ktMINE

ktMINE is an innovation and intellectual property information firm founded in 2008. Focused on mining, organizing and connecting the world's IP information, ktMINE provides businesses across the globe access to insights on industry players, technologies, and developments.

Gain powerful insights through connected data.

ktMINE has integrated and connected disparate datasets into a single platform. The platform quickly pulls and organizes data on companies, technologies, and industries across many distinct datasets. Users can gain a snapshot of information, view detailed information with full-text, access comprehensive corporate portfolios, and build custom company portfolios.

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MEET THE AUTHORS

At ktMINE, Megan and John collaborate on research driven projects and data deliverables.

Megan Rouke

As a Research Analyst, Megan analyzes intellectual property and licensing data sets to uncover market trends and company innovations. Megan uses this knowledge to provide ktMINE users with actionable insights based on the most up-to-date intellectual property data. As she interacts with these data sets on a daily basis, she knows the in's and out's of all things licensing and IP related.

John Wiora

As the Director of Operations at ktMINE, John ensures that the day-to-day operations and innovations best serve the needs of the market. Wiora leads the analyst team and investigates how intellectual property and licensing research can be improved to provide insightful trends around companies and industries. John has collaborated and conducted research for various industry articles.