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# Editorial

## Good Headlamp Aim Must Be In Our Top Priorities

I have always considered that the aiming is one of the most important conditions to achieve good lighting. During the many years I was actively involved with engineering headlamps, I struggled to achieve good aim in static and dynamic conditions—in all vehicles, not just premium cars. Really it is not debatable that automatic levelling is necessary for all headlamps, not just those with certain technologies or light source lumens.

For decades upon decades, we have made improvements in static aiming, but the progress is going slowly and it is not enough. Too many drivers are still dazzled because of lamps aimed too high (or aimed correctly but pushed upward by vehicle load or acceleration squat), and too many drivers are seeing less than 20 metres ahead at night because of lamps aimed too low (or aimed correctly but pushed downward by brake dive). It is sad and alarming, in today's vision-zero context, to see the enormous strides we've made in headlamp performance nullified by this ancient problem. UN Regulations really must go in the direction suggested by Poland's Dr. Tomasz Targosinski. And, perhaps even more importantly, the US regulations have to get serious about headlamp aim.

In a forthcoming newsletter we will describe the status of innovations in aiming to allow for safer night driving. This week we set the stage: DVN's Daniel Stern describes and analyses Dr. Targosinski's proposal.

Sincerely yours

# In Depth Lighting Technology

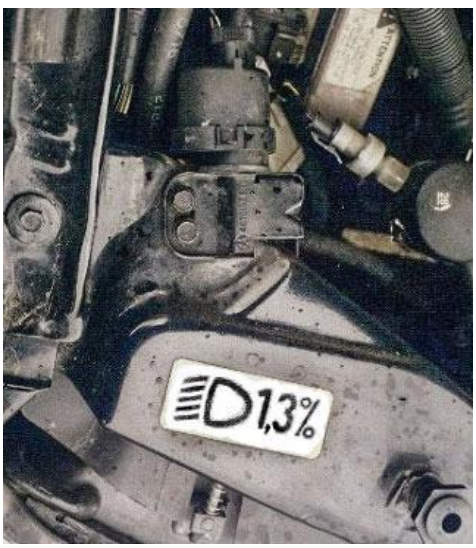
## Low Beam Aim Needs an Overhaul—A Look at the Proposal

### *Analysis by Daniel Stern, DVN Chief Editor*

DR. TOMASZ TARGOSINSKI

*Dr. Tomasz Targosinski, of Poland's Motor Transport Institute, is that country's expert delegate to GRE. He has better ideas for how low beam aim ought to be specified in the regulations. In this article we compare today's situation with the proposal put forth by Targosinski under the auspices of the GRE Informal Working Group on Visibility, Glare, and Levelling.*

The nature of a headlight beam is that its real, actual performance depends on where it's pointed; that is, how it's aimed. Whether it be an old-fashioned parabolic reflector with an H4 bulb or the newest high-brightness LEDs with efficient, low-loss optics, headlamp aim is by far the main thing that determines how well the driver can (or can't) see at night, and how much glare they're throwing around. An UMTRI study found that low beams aimed 1.3° lower than intended provide only nine to 21 per cent of their intended light on pedestrians ahead and to the right or left. We've **written before about the bad situation in North America**, where US and Canadian national regulations don't require new vehicles to come with correctly-aimed headlamps, aim is almost never checked, and it's almost impossible to get a proper headlamp aim job done.



The situation is quite different in Europe (and most of the rest of the world where European-sourced UN Regulations are used): initial aim is prescribed in detail, the aim angle for any given vehicle is called out on an underhood label—as shown here—or moulded into the headlamp housing itself, and aim is checked and adjusted during periodic vehicle inspections. That all sounds much better, doesn't it? Certainly much more fastidious. But if the original prescription is faulty, the callout will be faulty, and the headlamps will be fastidiously aimed wrong, where "wrong" means the headlamps won't be able to provide seeing distance adequate for normal road speeds, even if by design they are capable of it.

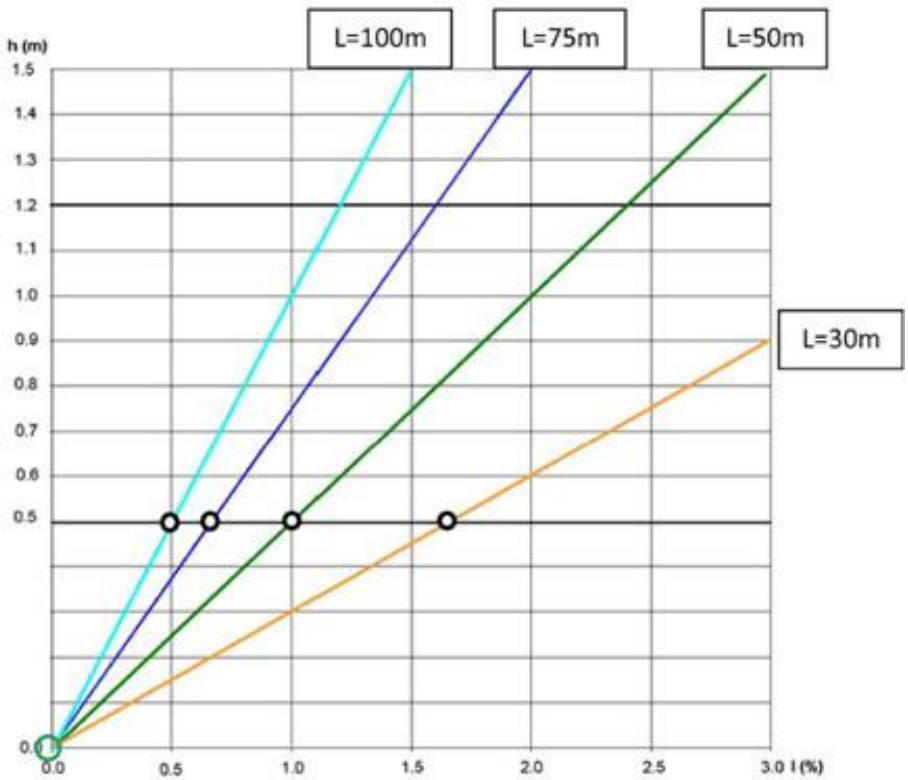
The trouble is the difference between the aim specified and assumed when headlamps are designed and tested, and the aim specified when those same headlamps are installed on vehicles. UN Regulation 149 (like R8, R20, R98, and R112 before the consolidation), which sets forth design and performance requirements, specifies that low beams shall be aimed with 1% (0.57°) declination.

But R149 and its predecessors apply only as far as the design and homologation of the headlamp. Then Regulation 48 takes effect; it sets forth how headlamps are to be installed on vehicles—including the upper and lower limits of their aim angle, which varies with lamp mount height.
For lamps mounted less than 80 cm above the road surface, the range is 0.5% to 2.5% (0.29° to 1.43°) down; for lamps mounted between 80 and 100 cm above the road, the aim may be as much as 3% (1.72°) down. Conformity-of-production values are even looser, as low as 3.5% (2°) down.  Where's our seeing light now? Let's do some trigonometry, and we find the low beam seeing distance is:

- 148m if aimed 0.29° or 0.5% down
- 107m if aimed 0.40° or 0.7% down (the US VOL specification)
- 75m if aimed 0.57° or 1% down
- 54m if aimed 0.80° or 1.4% down
- 50m if aimed 0.86° or 1.5% down
- 38m if aimed 1.14° or 2% down
- 30m if aimed 1.43° or 2.5% down
- 25m if aimed 1.72° or 3% down
- 21m if aimed 2.00° or 3.5% down

That's an enormous range of seeing distance, with a resultant enormous range of maximum safe speed above which the driver is functionally driving in the dark, unable to see far enough to react in time to an obstacle. Even if we disregard the looser CoP range and the levelling-limits range and look only at the somewhat narrower limits in R48 for initial aim—1 to 2% down—that's still a 2:1 ratio of seeing distance (not accounting for the relatively minor effect of lamp mount height on seeing distance with aim held constant).

National vehicle inspection standards don't swing in to remedy the situation; they tend to specify low aim angles, as well. The safety implications are magnified by the tendency of higher-mount headlamps with lower specified aim angles to be found on bigger, heavier, less manœuvrable vehicles with longer stopping distances. Here's a graphical representation of this effect. The X-axis is lamp aim declination in degrees, the Y-axis is lamp mount height in metres, and "L" is the seeing distance:

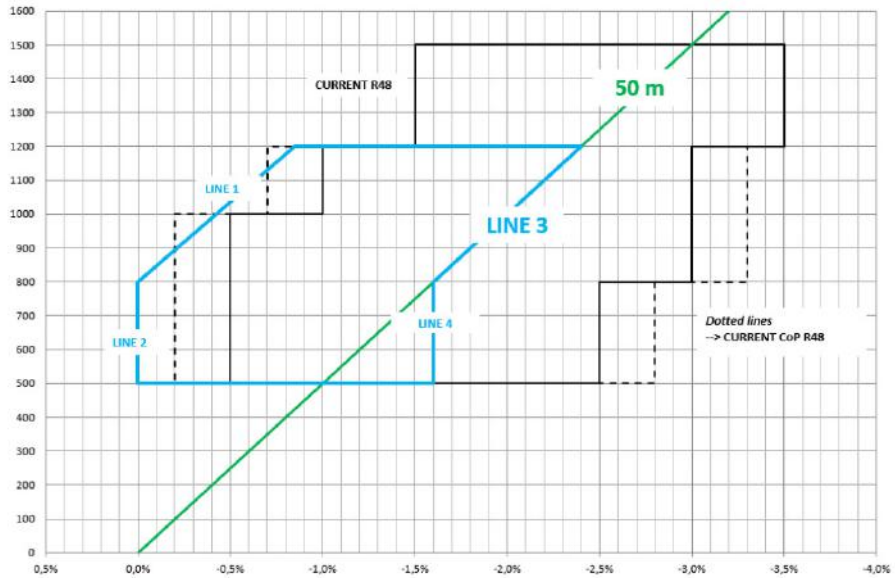



The aim provisions in R48 are old. At first, in the 1970s-'80s, initial aim between 1% and 1.5% down was specified, depending on mount height. That gave a 1.5:1 ratio between shortest and longest seeing distance—actually a slightly lower ratio because of the mount-height effect. But passenger and cargo loads in a vehicle will tend to raise the cutoff and cause glare, so the initial-aim tolerances were widened to create levelling tolerances, and load requirements were introduced; the idea was that the aim angle should not rise above the top of the allowable range

at any of the vehicle load conditions specified by the regulation. That's when the underhood aim angle labels first appeared. The next change was to divide the aim chart into two and then three parts for a variety of lamp mount heights.

And that's where things have stayed up to now. Given the technical and technological limits of aim attainment and maintenance mechanisms—manual and automatic alike—It was arguably a reasonable way at that time of grappling with the European cultural aversion to glare (about which more below). But now we have much better hardware to dial in the correct aim and have it stay put, and much more precise, accurate, and durable automatic levellers to keep the aim constant within 0.1 per cent.

So it's high time to reconcile the giant gap between the type-approval assumption and the on-vehicle reality. That's been a project of the GRE Informal Working Group on Visibility, Glare, and Levelling (IWG-VGL), and Dr. Tomasz Targosinski of Poland has been tirelessly working to update R48's initial-aim specifications. He's put up proposal intended to guarantee real-world safety by aligning R48's initial-aim and levelling tolerances with R149's aim assumptions and specifications. Here's what the present staircase-shaped aim box looks like in R48, with the IWG-VGL proposal for a new aim box overlaid in blue. Here again, the X-axis is aim declination, and the Y-axis is lamp mount height:




The new box is shifted significantly to the left, thus constraining the lower limit and expanding the upper limit of aim declination. This would tend to encourage higher lamp aim, which means longer seeing distance and better safety.

The green line here is worth particular attention; it has been calculated to guarantee no less than a 50-metre preview for the driver (vertical illuminance of ≥ 3 lux per headlamp at the right edge of the road surface). Thus, this —unlike the current R48 aim box—is a performance-based requirement.

The proposal was put forth at GRE this past October, and can be found **here**. It is well worth reading in its entirety, along with its supporting documents such as **this one** and **this one**. There is progress being made—finally, at great long last, the end may be near for the decades-old 'gentlemen's agreement' to postpone requiring automatic levelling on all vehicles!—but there is still some friction and pushback happening. Some countries' experts are opposed to anything they're afraid could potentially increase glare, in a manifestation of the glare-aversion mentioned earlier. In Europe it has long been faithfully taken as a matter of received wisdom that any and all glare is categorically bad and its avoidance must be prioritised. This philosophy exerts at every stage of the game: it is why R48's aim angles go so low; it is why national vehicle-inspection standards allow such low aim, and it is why workshops and garages tend to consider it a good safety measure to aim headlamps lower rather than higher.

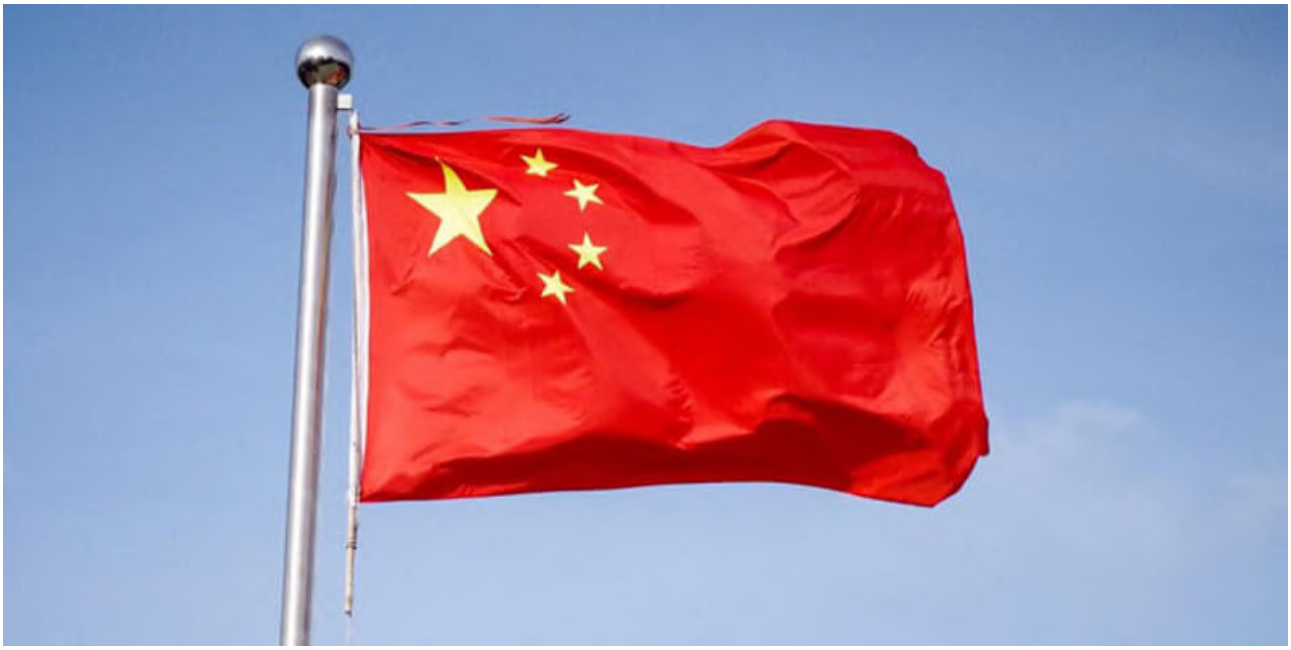
Certainly glare is uncomfortable, and it's well to strive to minimise it to the maximum practicable degree consistent with safety. That last bit is crucial, for very little rigourous scientific evidence causally links headlight glare to traffic collisions. The American philosophy, singlemindedly fixated on seeing distance and regarding glare control as an optional incidental consideration unimportant to safety, probably isn't compatible with societies where glare is simply not accepted, no matter the safety consequences of that preference. But on the other hand, zero glare is not a reasonable or scientifically defensible expectation from unadaptive low beam headlamps. By definition, low beams are a compromise between seeing and glare. The proposal advocated by Dr. Targosinski certainly looks like a better, safer compromise than what's presently specified in R48; with favourable luck—and continued diligent work by the whole of the IWG-VGL and patient, open-minded negotiation within the greater GRE—it will be put into effect soon.

That giant, aim-induced gap between intended and realised low beam performance, incidentally, might not have been all to the bad; perhaps it may have played a role in spurring the development of ADB: if glare is flatly not accepted and so low beams give inadequate seeing distance, that's an impetus to provide more seeing light without more glare. Research has found ADB gives a 30-metre increase in effective seeing distance versus low beams (aimed in accord with R48)…voilà! But until all cars have ADB, let's get the low beams pointed where they really should be.

# Lighting News

## Chinese Automakers Gain Ground in Innovation

LIGHTING NEWS



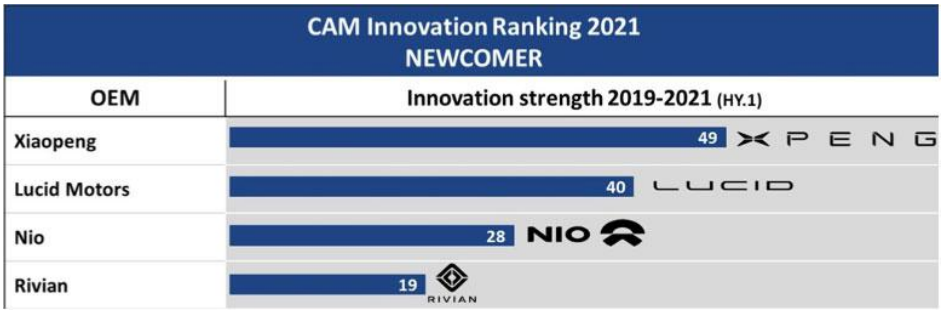
Every year since 2016, German research institute the Centre for Automotive Management (CAM) has examined the vehicle technology innovations of 30 car manufacturers with over 80 car brands. The basis of the long-term comparison is 2900 innovations that became available in series-produced vehicles between 2016 and 2021.

| OEM | Rank | | Innovation strength in a period comparison | |
|---|---|---|---|---|
| | 2019-2021 (HY.1) | 2016-2018 | 2019-2021 (2016-2018) | Growth |
| VW VOLKSWAGEN | 1 | 1 | 366 | - 11% |
| BMW BMW GROUP | 2 | 3 | 282 | + 37% |
| Daimler DAIMLER | 3 | 2 | 269 | - 20% |
| Tesla TESLA | 4 | 4 | 199 | + 37% |
| Hyundai HYUNDAI MOTOR GROUP | 5 | 5 | 141 | + 16% |
| Ford Ford | 6 | 11 | 138 | + 103% |
| Stellantis STELLANTIS | 7 | 7 | 136 | + 24% |
| BYD BYD | 8 | 20 | 127 | + 303% |
| GreatWall GWM | 9 | 16 | 116 | + 164% |
| Geely GEELY | 10 | 6 | 100 | - 15% |

TOP-10 AUTOMAKERS FOR INNOVATION STRENGTH 2016-2018 AND 2019-2021 (CAM)

So far, the German makers have maintained their strong position even in the transformation phase of the industry since 2015. The Volkswagen Group leads with 366 index points despite a slight decline. The innovation performance in 2019-21 is driven in particular by innovations in the technology fields of electric drive and operating and display concepts. BMW moves up to second place among the most innovative manufacturers with 282 index points (+37%) and displaces Daimler (Mercedes-Benz) who dropped to № 3. Tesla rank fourth with world firsts ready for series production in electric drive (e.g. range optimisation Model S) and driver assistance systems (e.g.

Navigate / "Autopilot" in the Model 3).
Hyundai cling to fifth place with innovations such as the lowest power consumption of the Kia e-Soul. And newly this year, three Chinese makers enter the top-10 rankings: BYD, GreatWall, and Geely.




CAM AUTOMOTIVE INNOVATIONS NEWCOMER RANKING 2021

According to the CAM analysis, the entry of Chinese and American newcomers is fundamentally changing the global automotive market. In response, CAM published this newcomer ranking, which compares the innovative strength of the four EV startups Xiaopeng, Lucid, Nio, and Rivian in the 2019-21 period under review.

# New Hella Black Magic LED Auxiliary Lamps

LIGHTING NEWS

Hella have launched a new Black Magic range of auxiliary lamps on the European market, with dustproof and waterproof housings and robust construction especially well suited for off-road applications.
In North America Hella received two awards for the new lamps—the AAPEX Award and the Sema Global Media Award 2021, which is awarded by Mas Motor magazine in Mexico.

Stefan van Dalen, responsible for Hella's global aftermarket business, says "With the new Hella Black Magic LED series, we are ushering in a new era in auxiliary lights. They combine powerful LED light output with a slim and stylish all-black design". The range includes cubes, light bars, and mini-bars. Depending on the variant they provide outstanding off-road illumination with up to 15,000 lumens. A specially developed reflector ensures a homogeneous illumination.

The integrated, intelligent thermal management system ensures adaptation to the ambient temperature and thus always provides an optimal light output and a longer lifetime of the LEDs.  The Black Magic LED series are available as flood and spotlight versions and can be mounted upright or pendant for easy integration.

# Marelli AL Break China Plant Ground

LIGHTING NEWS


Marelli Automotive Lighting held a groundbreaking ceremony for their Wuhu enlargement project on the ground of the Marelli Automotive Lighting electronics plant, together with WEDA (Wuhu Economic and Technological Development Area). Government representatives and Marelli's management team attended the ceremony: among them, David Fan, President of Marelli China, Aymeric Hommel, President of Marelli Automotive Lighting Asia, and Peter Cao, Head of Marelli Automotive Lighting China.

The Marelli Automotive Lighting enlargement project foresees a plant for electronics aimed at automotive lighting and an R&D centre for a total area of 21,000 $m^2$. The new lighting electronics plant will start production at the end of this year. The R&D centre will have more than 100 engineers with capability of optics and electronics, becoming an extension of the Shanghai R&D centre.

With the growing demand in the Chinese market for vehicle lighting and lighting electronics, Marelli AL initiated this strategic project in the last months and is now in its construction phase. With the completion planned for the first quarter of 2023 for the whole project, it will contribute to growth not only in China but also in the greater Asian region, both in electronics manufacturing and R&D capability.

# J.W. Speaker: Exclusive Supplier for Arch Motorcycles

LIGHTING NEWS


J.W. Speaker,noted American makers of cutting-edge vehicle lighting equipment, are now the exclusive supplier of lighting for Arch Motorcycle, a Los Angeles-based bespoke production motorcycle company.

J.W. Speaker developed the world's first dynamically adaptive motorcycle headlamp (as **reported** in DVN) which responds to motorcycle bank angles in real time, automatically sending light into the curve so the driver can see where they're headed. Now, Speaker will provide premium LED headlamps for all Arch motorcycles built in 2022, including the KRGT-1 and the upcoming 1s and Method 143 models. J.W. Speaker and Arch will also partner in developing customised LED lighting technology for future models.
J.W. Speaker marketing director Trish Logue says "We're beyond thrilled to be working with Arch Motorcycle as their lighting partner for 2022 builds and beyond. We look forward to collaborating with the Arch team; Arch Motorcycle has built its brand around utilizing best-in-class components and we're proud to be part of its roster of partners".

# Driver Assistance News

## IIHS Sets New Partial-Automation Criteria

DRIVER ASSISTANCE NEWS


IIHS, the US-based Insurance Institute for Highway Safety, have released a **new rating program** for vehicles with partial automation, one which no car on the market can pass without changes.
The rating system requires safeguards that vehicles with partial automation should employ to help drivers stay focused and not treat these systems, such as Tesla's so-called "Autopilot" and Volvo's Pilot Assist, as self-driving cars. Currently there are no self-driving cars available to consumers. IIHS President David Harkey says "We are worried that these systems are advertised to do certain things, such as drive hands-free and perhaps become disengaged from driving; there is a message being conveyed to consumers that perhaps these systems can do more than they are intended to".

Vehicles will receive a rating of good, acceptable, marginal, or poor. A *good* rating requires that a car monitors whether drivers keep their hands on the steering wheel and whether they look at the road. It also requires that automated lane changes be initiated by the driver, among other things. The systems must use many alerts to remind the driver of these criteria, and if the driver fails to respond, the vehicle should slow to a crawl or stop. The most common criterion cars currently on the market fail are monitoring the hands and automated lane change, Harkey says, noting that many automobiles are even promoted as enabling drivers to use partial automation without holding the steering wheel, and some even allow drivers to use partial automation without wearing a seat belt.

But most of these problems should not be hard to solve. While these requirements cannot force the driver to focus, they allow the driver to be able to take over control quickly if needed. The main goals of these new criteria are not only to set a standard for safety but to change how automakers and customers talk about partial automation. It is not just the job of the automaker to market these systems more clearly, Harkey said, but the driver must use them safely, too.

# Mobileye Lanekeeping Works Without Lane Lines

DRIVER ASSISTANCE NEWS

E-vehicles from the Volkswagen Group are the first to get a lane departure warning system from Intel subsidiary Mobileye, which works even without the otherwise necessary lane markings. Instead of being guided by white or yellow lines on the road, the system follows the line that other vehicles have traced previously on the road, based on amassed data. It's an innovation embedded in reality, where roads could be damaged, worn out, and covered by snow or ice.

Mobileye's Johann Jungwirth says "Today, conventional lane assistants can only be used on about half of the driven kilometres [because] markings are missing, or they cannot be recognised by the vehicle's cameras due to rain, snow or dirt".

Volkswagen are integrating the corresponding information from Mobileye's cloud database into their driver assistance system for semi-autonomous driving. The globally aggregated swarm data can then be used in the electrified VW, Škoda, and Seat models based on the VW Group's MEB platform.
Ford plan to use Mobileye's Road Experience Management technology in future versions of the "Blue Cruise" driver assistance system with stop-and-go and lane-centring technology, so customers will eventually be able to drive their vehicles hands-free while being supervised by a camera which detects whether the driver is concentrating on the road.

Mobileye also presented a chip system for autonomous driving up to $L^4$, with market launch slated for 2025. Jungwirth says "Autonomous driving becomes possible with the new chip, you then usually only have a second smaller processor for redundancy…the time of self-driving cars is now really dawning. I don't see anything that can stop us, neither regulatory, nor technical, nor in terms of customer acceptance".

# Mercedes, Luminar in New Lidar Pact

DRIVER ASSISTANCE NEWS

Luminar have established their latest automotive partnership with Mercedes-Benz. It will involve series production of sensors, enhancing the automaker's automated highway driving systems.
There's not yet a timetable for when Luminar's "Iris" lidar will be installed in passenger vehicles, nor specific vehicle models chosen.

As part of the agreement, Mercedes-Benz will take a financial stake in Luminar; namely, 1.5 million shares of Luminar stock, at around USD $13 per share.

The Mercedes-Benz partnership is Luminar's ninth overall, and their third for conventional passenger vehicles. Luminar now work with many leading global automakers including Toyota and China's SAIC.

Lidar sensors use lasers to detect objects in the traffic environment and measure their distance from vehicles. With the lone exception of notoriously cocksure Tesla CEO Elon Musk, who has said lidar is "for losers" and anyone relying on it is "doomed", the entire automotive and autonomous-drive industry consider lidar is an essential component in advanced driver-assist systems.

# TriEye Collaborates with Hitachi Astemo on ADAS

DRIVER ASSISTANCE NEWS


The TriEye SEDAR is the ultimate perception solution, enabling autonomous vehicles and ADAS with HD imaging and depth perception capabilities in all weather and lighting conditions.

TriEye, the pioneer of the world's first mass-market Short-Wave Infrared (SWIR) sensing technology, announces collaboration with Hitachi Astemo, Tier 1 automotive supplier of world-class products. Combining their expertise, the companies will work together to further enhance the capabilities of ADAS for adverse weather and low-light conditions by accelerating the launch of TriEye technology.

The SEDAR (Spectrum Enhanced Detection And Ranging), has also received significant recognition when it was named CES 2022 Innovation Award Honoree, in the Vehicle Intelligence category. TriEye's SEDAR, based on the world first CMOS based sensor, the Raven, uniquely operates in the SWIR spectrum, enabling HD SWIR imaging and deterministic 3D mapping - in one sensor modality.

Hitachi Astemo manufactures systems for major OEMs, using their leading-edge facilities to develop technologies and ensure maximum quality. Applying this expertise, Hitachi Astemo will evaluate the SEDAR and validate that it can be easily integrated into their ADAS system to deliver mission-critical 2D and 3D depth information under low-visibility conditions.
"We believe that TriEye's SEDAR can provide autonomous vehicles with ranging and accurate detection capabilities that are needed to increase the safety and operability under all visibility conditions." said John Nunneley, Senior VP, Design Engineering, Hitachi Astemo.

*TriEye is the pioneer of mass-market, CMOS-based Short-Wave infrared (SWIR) sensing solutions. TriEye's breakthrough and proprietary technology enables cost-effective, high-resolution image data and depth perception in all weather and lighting conditions.*
*Hitachi Astemo Americas manufactures and markets engine management, electric powertrain, integrated vehicle control for major automotive manufacturers worldwide.*

# General News

## European Sales Fell in '21

GENERAL NEWS

Full-year registrations for 2021 are down 1.5 per cent, according to industry group ACEA.
Groups that could navigate the shortage best made the biggest gains, namely Hyundai and Toyota. But others, such as Renault, Daimler and Volkswagen Group, saw steep drops in both sales and market share.
The VW marque remained the № 1 brand in Europe, but its 2021 sales were down 6 per cent to 1,274,000.
Peugeot ranked second, down 2.3 per cent at 724,000.

There were 11,775,000 passenger cars registered in 2021 in the EU, the UK and the EFTA markets. The market was down 25 per cent compared with 2019, when there were 15,805,000 passenger cars sold.

**Hyundai Group**, were Europe's biggest mover, with 1,018,000 sales, a 21 per cent increase. **Toyota** brands, including Lexus, were up 9.6 per cent to 760,178, and their market share rose to 6.5 per cent from 5.8 per cent in 2020. **Stellantis** were just below the market level, with 2,379,000 sales for a 1.8 per cent decline. Their market share was 20 per cent, the same as in 2020. **VW Group** remained Europe's largest automaker, with 2,944,000 sales, but sales fell by 3.7 per cent, for a 25 per cent market share. **Renault Group**, Europe's third-largest, had 1,093,000 sales, sharply lagging the market with an 11 per cent decline. Market share was 9.3 per cent, a full percentage point less than in 2020.

**Europe's Top 10 brands, 2021**

| Brand | 2021 sales | Change |
|---|---|---|
| Volkswagen | 1,274,000 | −6% |
| Peugeot | 724,000 | −2% |
| Toyota | 712,000 | +10% |
| BMW | 682,000 | +1% |
| Renault | 678,000 | −17% |
| Mercedes | 642,000 | −13% |
| Audi | 597,000 | −1% |
| Skoda | 589,000 | −9% |
| Ford | 523,000 | −19% |
| Hyundai | 515,000 | +22% |

Total in 2021 = 11,775,000
-25% vs 2019 at 15.8 million

# Ford Predict $8bn Gain From Rivian Investment

GENERAL NEWS

Ford expect to book an $8.2bn gain for the fourth quarter of 2021 from their investment in Rivian. Ford, having invested over $800m, carried a roughly 12 per cent stake in Rivian when the latter went public in November. Although the two companies late last year canceled plans to jointly develop a vehicle, Ford CEO Jim Farley said he is pleased with Rivian and happy with the investment.

The Rivian gain was one of a number of special items Ford plan to report when they will release earnings next month. Ford also said they will reclassify a previous $900m non-cash gain from Rivian into special items, so that figure will no longer be included in the adjusted EBIT forecast.