Your Driverless Ride Is Arriving

Uber thinks its self-driving taxis could change the way millions of people get around. But autonomous vehicles aren't anywhere near to being ready for the roads.

By Will Knight

Illustration by Jean Jullien

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Outside a large warehouse in Pittsburgh, in an area along the Allegheny River that was once home to dozens of factories and foundries but now has shops and restaurants, I'm waiting for a different kind of technological revolution to arrive. I check my phone, look up, and notice it's already here. A white Ford Fusion, its roof bedazzled with futuristic-looking sensors, is idling nearby. Two people sit up front—one monitoring a computer, the other behind the wheel—but the car is in control. I hop in, press a button on a touch screen, and sit back as the selfdriving Uber takes me for a ride.

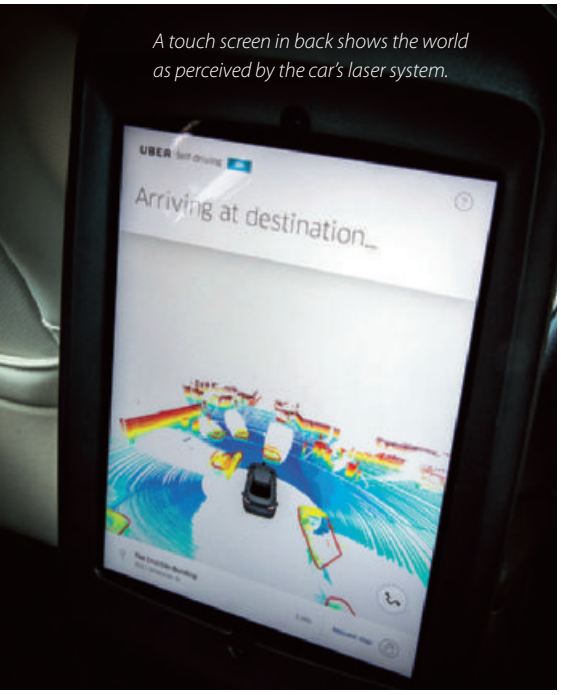
As we zip out onto the road toward downtown, the car stays neatly in its lane, threading deftly between an oncoming car and parked trucks that stick out into the street. I've been in a self-driving car before, but it's still eerie to watch from the back seat as the steering wheel and pedals move themselves in response to events unfolding on the road around us.

To date, most automated vehicles have been tested on highways in places like California, Nevada, and Texas. Pittsburgh, in contrast, features crooked roads, countless bridges, confusing intersections, and more than its fair share of snow, sleet, and rain. As one Uber executive said, if self-driving cars can handle Pittsburgh, then they should work anywhere. As if to test this theory, as we turn onto a bustling market street, two pedestrians dart onto the road ahead. The car comes to a gentle stop some distance from them, waiting and then continuing on its way.

A screen in front of the back seat shows the car's peculiar view of the world: our surroundings rendered in vivid colors and jagged edges. The picture is the product of some of an amazing array of instruments arranged all over the vehicle. There are no fewer than seven lasers, including a large spinning lidar unit on the roof; 20 cameras; a high-precision GPS; and a handful of ultrasound sensors. On the screen inside the car, the road looks aqua blue, buildings and other vehicles are red,

yellow, and green, and nearby pedestrians are highlighted with what look like little lassos. The screen also indicates how the vehicle is steering and braking, and there's a button that'll ask the car to stop the ride any time you want. This being 2016, Uber has even made it possible for riders to take a selfie from the back seat. Shortly after my ride is over, I receive by e-mail a looping GIF that shows the car's view of the world and my face grinning in the top-right corner. People on the sidewalk stop and wave while we wait at a traffic light, and a guy driving a pickup behind us keeps giving the thumbs-up.

My ride is part of the highest-profile test of self-driving vehicles to date, after Uber began letting handpicked customers book rides around Pittsburgh in a fleet of automated taxis. The company, which has already upended the taxi industry with a smartphone app that lets you summon a car, aims to make a significant portion of its fleet self-driving within a matter of years. It's a bold bet that the technology is ready to transform the way millions of people get around. But in some ways, it isa bet that Uber has to make. In the first-half of this year it lost a staggering $1.27 billion, mostly because of payments to-drivers. Autonomous cars offer "a greatop-portunity for Uber," says David Keith, an assistant professor at MIT who studiesin-novation in the automotive industry, "but there's also a threat that someone else beats them to market."

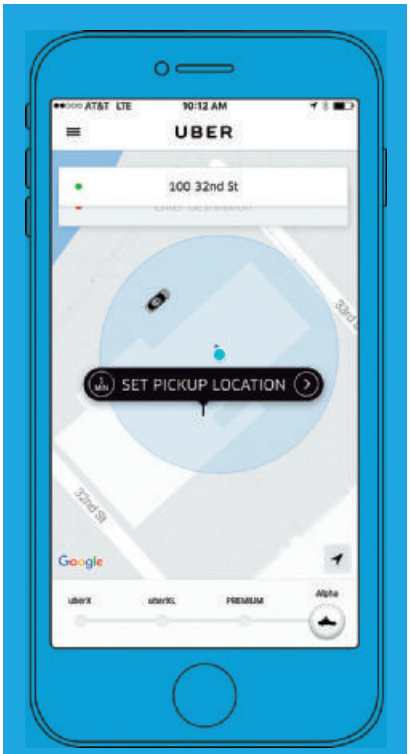


A touch screen in back shows the world as perceived by the car's laser system.

Most carmakers, notably Tesla Motors, Audi, Mercedes-Benz, Volvo, and General Motors, and even a few big tech companies including Google and (reportedly) Apple, are testing self-driving vehicles. Tesla cars drive themselves under many circumstances (although the company warns drivers to use the system only on highways and asks them to pay attention and keep their hands on the steering wheel). But despite its formidable competition, Uber might have the best opportunity to commercialize the technology quickly. Unlike Ford or GM, it can limit automation to the routes it thinks driverless cars can handle at first. And in contrast to Google or Apple, it already has a vast network of taxis that it can make gradually more automated over time.

Uber's executives have little trouble imagining the upside. With no drivers to split revenues with, Uber could turn a profit. Robot taxis could become so cheap and easy to use that it would make little sense for anyone to actually own a car. Taken to its logical conclusion, automated driving could reprogram transportation itself. Uber is already experimenting with food delivery in some cities, and it recently bought Otto, a startup that is developing automated systems for long-haul trucks. Self-driving trucks and vans could ferry goods from fulfillment centers and stores to homes and offices with dizzying speed and effi ciency. Shortly before my test ride Andrew Lewandowski, head of Uber's autonomous operations, a veteran of Google's self-driving program, and one of the cofounders of Otto, said: "I really believe that this is the most important thing computers are going to do in the next 10 years."

Uber is moving quickly. The company created its Advanced Technology Center,



An experimental version of Uber's app shows an automated car roaming nearby.

where it's developing its driverless cars, in February 2015 by hiring a number of researchers from the robotics department at nearby Carnegie Mellon University. Using that expertise, Uber developed its self-driving taxis in a little over a year—roughly the amount of time it takes most automakers to redesign an entertainment console.

But is it moving too quickly? Is the technology ready?

Robo ancestors

For the rest of my time in Pittsburgh, I get around using Ubers controlled exclusively by humans. The contrast is stark. I want to visit CMU's National Robotics Engineering Center (NREC)—part of its Robotics Institute, one of the pioneering research groups involved in developing selfdriving vehicles—to see what its experts think of Uber's experiment. So I catch a ride with a guy named Brian, who drives a beat-up Hyundai Sonata. Brian says he's seen several automated Ubers

around town, but he can't imagine a ride in them being as good as one with him. Brian then takes a wrong turn and gets completely lost. To be fair, though, he weaves through traffic just as well as a self-driving car. Also, when the map on his phone leads us to a bridge that's closed for repairs, he simply asks a couple of road workers for directions and then improvises a new route. He's friendly, too, off ering to waive the fare and buy me a beer to make up for the inconvenience. It makes you realize that automated Ubers will off er a very diff erent experience. Fewer wrong turns and overbearing drivers, yes, but also no one to help put your suitcase in the trunk or return a lost iPhone.

I take a rain check on the beer, say good-bye to Brian, and arrive at NREC's vast warehouse about 20 minutes late. The building is filled with fascinating robotic prototypes. And if you look carefully, you'll find some ancestors of today's automated vehicles. Just inside the entrance, for instance, is Terregator, a six-wheeled robot about the size of a refrigerator, with a ring of sensors on top. In 1984, Terregator was among the fi rst robots designed to roam outside of a lab, rolling around CMU's campus at a few miles per hour. And Terregator was succeeded, in 1986, by a heavily modified van called NavLab, one of the fi rst fully computercontrolled vehicles on the road. Just outside the front door to NREC sits another notable forerunner: a customized Chevy Tahoe fi lled with computers and decorated with what looks suspiciously like an early version of the sensor stack on top of one of Uber's self- driving cars. In 2007 this robot, called Boss, won an urban driving contest organized by the U.S. Defense Advanced Research Projects Agency. It was a big moment for automated vehicles, proving that they could navigate ordinary traffi c, and just a few years later Google was testing self-driving cars on real roads.

"We are cognitive, sentient beings. We comprehend, we reason, and we take action. When you have automated vehicles, they are just programmed to do certain things for certain scenarios."

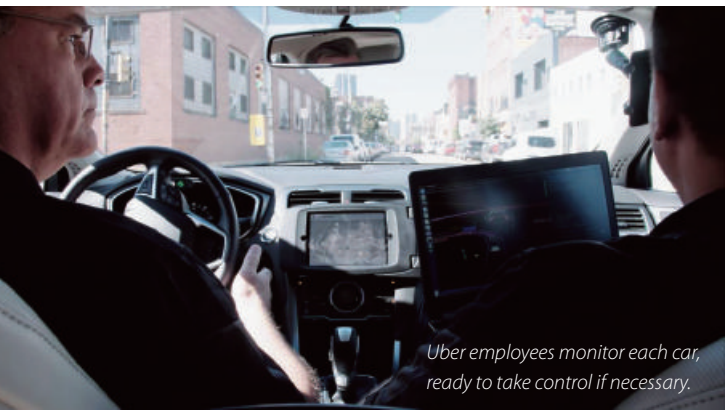
The three of these CMU robots show how gradual the progress toward self-driving vehicles was until recently. The hardware and software improved, but the system struggled to make sense of the world a driver sees, in all its rich complexity and weirdness. At NREC, I meet William "Red" Whittaker, a CMU professor who led the development of Terregator, the first version of NavLab, and Boss. Whittaker says Uber's new service doesn't mean the technology is perfected. "Of course it isn't solved," he says. "The kinds of things that aren't solved are the edge cases."

And there are plenty of edge cases to contend with, including sensors being blinded or impaired by bad weather, bright sunlight, or obstructions. Then there are the inevitable software and hardware failures. But more important, the edge cases involve dealing with the unknown. You can't program a car for every imaginable situation, so at some stage, you have to trust that it will cope with just about anything that's thrown at it, using whatever intelligence it has. And it's hard to be confident about that, especially when even the smallest misunderstanding, like mistaking a paper bag for a large rock, could lead a car to do something unnecessarily dangerous.

Progress has undoubtedly picked up in recent years. In particular, advances in computer vision and machine learning have made it possible for automated vehicles to do more with video footage. If you feed enough examples into one of these systems, it can do more than spot an obstacle—it can identify it with impressive accuracy as a pedestrian, a cyclist, or an errant goose.

Still, the edge cases matter. The director of NREC is Herman Herman, a roboticist who grew up in Indonesia, studied at CMU, and has developed automated vehicles for defense, mining, and agriculture. He believes self-driving cars will arrive, but he raises a few practical concerns about Uber's plan. "When your Web browser or your computer crashes, it's annoying but it's not a big deal," he says. "If you have six lanes of highway, there is an autonomous car driving in the middle, and the car decides to make a left turn— well, you can imagine what happens next. It just takes one erroneous command to the steering wheel."

Another problem Herman foresees is scaling the technology up. It's all very well having a few driverless cars on the road, but what about dozens, or hundreds? The laser scanners found on Uber's cars might interfere with one another, he says, and if those vehicles were connected to the cloud, that would require an insane amount of bandwidth. Even something



Uber employees monitor each car, ready to take control if necessary.

as simple as dirt on a sensor could pose a problem, he says. "The most serious issue of all—and this is a growing area of research for us—is how you verify, how you test an autonomous system to make sure they're safe," says Herman.

Learning to drive

For a more hands-on perspective, I head across town to talk to people actually developing self-driving cars. I visit Raj Rajkumar, a member of CMU's robotics faculty who runs a lab funded by GM. In the fast-moving world of research into driverless cars, which is often dominated by people in Silicon Valley, Rajkumar might seem a bit old school. Wearing a gray suit, he greets me at his office and then leads me to a basement garage where he's been working on a prototype Cadillac. The car contains numerous sensors, similar to the ones found on Uber's cars, but they are all miniaturized and hidden away so that it looks completely normal. Rajkumar is proud of his progress on making driverless cars practical, but he warns me that Uber's taxis might be raising hopes unreasonably high. "It's going to take a long time before you can take the driver out of the equation," he says. "I think people should mute their expectations."

Besides the reliability of a car's software, Rajkumar worries that a driverless vehicle could be hacked. "We know about the terror attack in Nice, where the terrorist driver was mowing down hundreds of people. Imagine there's no driver in the vehicle," he says. Uber says it takes this issue seriously; it recently added two prominent experts on automotive computer security to its team. Rajkumar also warns that fundamental progress is needed to get computers to interpret the real world more intelligently. "We as humans understand the situation," he says. "We are cognitive, sentient beings. We comprehend, we reason, and we take action. When you have automated vehicles, they are just programmed to do certain things for certain scenarios."

Uber's vehicles are festooned with different kinds of sensors.

In other words, the colorful picture I saw in the back of my automated Uber represents a simplistic and alien way of understanding the world. It shows where objects are, sometimes with centimeter precision, but there's no understanding what those things really are or what they might do. This is more important than it might sound. An obvious example is how people react when they see a toy sitting in the road and conclude that a child might not be far away. "The additional trickiness is that Uber makes most of its money in urban and suburban locations," Rajkumar says. "That's where unexpected situations tend to arrive more often."

What's more, anything that goes wrong with Uber's experimental taxi service could have ramifications for the entire industry. The first fatal crash involving an automated driving system, when a Tesla in Autopilot mode failed to spot a large truck on a Florida highway this spring, has already raised safety questions. Hastily deploying any technology—even one meant to make the roads safer—might easily trigger a backlash. "While Uber has done a great job of promoting this as a breakthrough, it's still quite a way away, realistically," says MIT's Keith. "Novel technologies depend on positive word of mouth to build consumer acceptance, but the opposite can happen as well. If there are terrible car crashes attributed to this technology, and regulators crack down, then certainly that would moderate people's enthusiasm."

I get to experience the reality of the technology's limits firsthand, about halfway through my ride in Uber's car, shortly after I'm invited to sit in the driver's seat. I push a button to activate the automated driving system, and I'm told I can disengage it at any time by moving the steering wheel, touching a pedal, or hitting another big red button. The car seems to be driving perfectly, just as before, but I can't help noticing how nervous the engineer next to me now is. And then, as we're sitting in traffic on a bridge, with cars approaching in the other direction, the car begins slowly turning the steering wheel to the left and edging out into the oncoming lane. "Grab the wheel," the engineer shouts.

Maybe it's a bug, or perhaps the car's sensors are confused by the wide-open spaces on either side of the bridge. Whatever the case, I quickly do as he says.

Will Knight is senior editor for AI and robotics at MIT Technology Review. *His feature "AI's Language Problem" appeared in the September/October issue.*

您叫的無人駕駛車快抵達了

Uber 認為推出自駕計程車可以改變數百萬人的交通方式。只不過，離無人駕駛車上路還早得很。

撰文：奈特
插圖：朱利安

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我在匹茲堡阿勒格尼河岸邊的一座大倉庫外，等待著革命性新技術到來，這裡從前工廠、鑄造廠林立，如今被商店、餐廳取而代之，我拿起手機查了一下，發現車子已抵達了。一輛白色福特 Fusion 已停在附近，車頂上的感測器看起頗具未來感。前座端坐著兩個人：一個盯著電腦，另一個坐在方向盤前，但車子卻在控制之中，我上了車，按下觸控式螢幕上的按鍵後，輕鬆仰靠，展開自動駕駛 Uber 的兜風之旅。

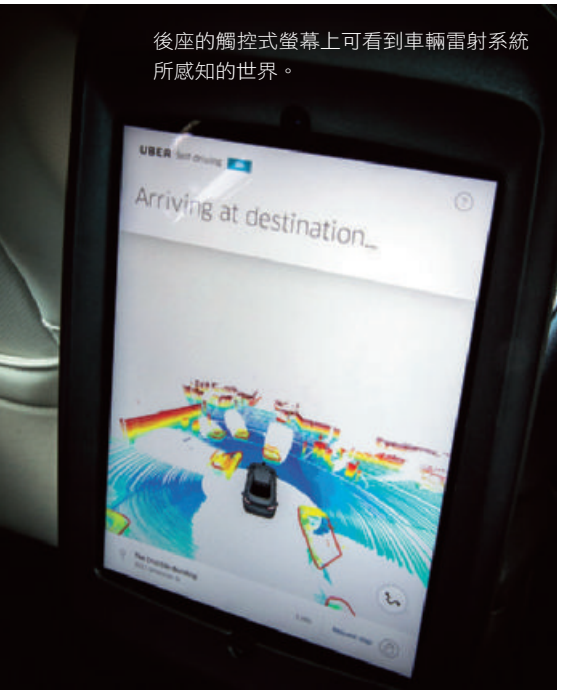
往市中心的路上，我們靈活地在來車和路邊斜停的卡車間穿梭，始終開在同一線車道上，雖然我搭過自動駕駛車，但從後座看方向盤和踏板自己隨路況反應動作，感覺非常詭異。

目前為止，大部分的自動駕駛車已在加州、內華達州、德州等地進行過高速公路實測。相較之下，匹茲堡道路蜿蜒，橋樑無數，路口混亂，雪霰和降雨都很豐沛，正如一位 Uber 主管所言，連匹茲堡都能搞定的話，自動駕駛車應該到哪都沒問題。說時遲，那時快，彷彿要驗證他這道似的，轉進一條熱鬧的市街時，前方突然有兩個人衝進馬路，我們的車不急不徐地離他們還有一段距離的位置停下，等行人通過才重新起步。

後座前方有一面螢幕顯示這輛車獨特的世界觀：四周環境以亮色的鋸齒狀輪廓線呈現，生成這個畫面的資訊來自佈滿全車的儀器大軍中至少七組雷射；車頂上的大型旋轉雷達、20 支影像紀錄器、超精密全球定位系統、幾個超音波感測器，車內顯示器上看到的水藍色是路，紅、黃、綠色是建物和其他車輛，小圈圈則是附近的行人，螢幕還顯示本車輛的轉向和制動情形，並有一個按鈕可隨時要求結束試乘，在

2016 年的現在，Uber 甚至讓後座乘客能自拍。在這趟試乘後，我收到一封電郵，裡面有一張循環動態 GIF 圖檔，是車子看出去的外界，右上角則是我的笑臉，我們在等紅燈時，人行道上有人停下來朝我們揮手，後方的卡車司機則是不斷向我們豎起大拇指。

這趟試乘屬於目前為止最高調的一系列自動駕駛車測試活動，之前 Uber 已經開放特選客戶在匹茲堡附近預約搭乘自動駕駛車，Uber 以智慧型手機叫車程式顛覆計程車業後，當前目標是在未來幾年內，將車隊大量換成自動駕駛車。此舉是大膽押注在科技已準備好改變數百萬人的交通方式。但就某些方面而言，Uber 非賭這把不可，今年上半年，Uber 已虧損驚人的 12.7 億美元，其中大半付給司機，麻省理工學院研究汽車製造創新的助理教授凱斯（David Keith）表示，自動駕駛車雖然是「Uber 的大好機會，但被別人搶得市場先機的威脅也不容小覷。」



後座的觸控式螢幕上可看到車輛雷射系統所感知的世界。

特斯拉、奧迪、賓士、富豪、通用在內的多數車廠，甚至 Google 和（據說）蘋果等大型科技公司，都在測試自動駕駛車，特斯拉電動車已經能在許多情況下自動駕駛（即使特斯拉警告駕駛人只能在高速公路上切到自駕模式，並要求駕駛留心路況，雙手不離開方向盤），強敵環伺下，Uber 仍最有希望早日將這項技術商業化。與福特或通用汽車不同，Uber 可以事先判斷無人駕駛車能應付那些路線，再限制自動駕駛車只走這些路線，況且，Uber 與 Google 或蘋果不同，Uber 可以在龐大的計程車隊基礎上，逐步汰換，提高無人駕駛車所占比例。

Uber 的主管不難想像這麼做的好處，少了司機瓜分收入，Uber 或許能轉虧為盈。機器人計程車會便宜又方便到買自有車顯得多此一舉，合理的結論是：自動駕駛將徹底改寫運輸本身。Uber 已開始在幾座城市試辦餐飲外送服務，最近又收購了開發長途貨車自駕系統的新創公司 Otto。自動駕駛卡車和麵包車能以驚人的速度與效率，將貨物從物流中心和商店配送到住家和公司，Uber 自動駕駛營運負責人勒萬道斯基（Andrew Lewandowski）曾任職 Google 自駕計畫，也共同創辦了 Otto，在我試乘前不久，他曾說：「我真心相信這會是電腦未來 10 年最重要的應用。」

Uber 動作很快，從鄰近的卡內基美隆大學機器人系聘請了一批研究員，在 2015 年二月創立研發無人駕駛車的高等技術中心（Advanced Technology Center），在專業人才協助下，Uber 只花一年多的時間就開發出自駕計程車，跟大多數車廠重新設計娛樂系統控制面板的時間差距不大。

但 Uber 會不會跑得太快？技術已經就緒了嗎？

測試版 Uber 應用程式顯示附近有自動駕駛車。

機器人遠祖

我在匹茲堡其他時間搭的 Uber，都是完全由司機操控，兩相比較，可謂天壤之別。前往卡內基美隆大學國家機器人工程中心（NREC，附設於機器人研究所，自動駕駛車開發領域的先驅團隊）採訪所內專家對 Uber 實驗的看法時，我搭上了布萊恩開的車，一輛破爛的現代 Sonata，布萊恩說他曾在市區看過幾次自動駕駛的 Uber，但他無法想像搭起來會跟坐他的車一樣好，才剛說完，他就轉錯一個彎，找不到路了，說句公道話，他在車陣中穿梭自如的程度，不輸自動駕駛車，此外，當他跟著手機導航開到一座施工中的橋時，只要向幾個工人問路，就知道替代道路怎麼走，他人也很好，為了彌補對我造成的不便，

主動提議不收車資，還要請我喝杯啤酒，這讓我意會到 Uber 自動駕駛車將帶來多麼不同的體驗，雖然走錯路和遇上蠻橫司機的機率會減少沒錯，但也沒人幫忙把行李放進後車廂，或歸還乘客遺忘的 iPhone。

答應改天讓他請喝啤酒後，我道別布萊恩，抵達國家機器人工程中心的庫房，比預訂晚了 20 分左右，這棟巨大建築裡充斥琳瑯滿目的機器人原型，仔細看會發現幾個現代自動駕駛車的遠祖，例如，一進門附近那個上有一圈感測器，下有六個輪子，冰箱大小的機器人，就　是「Terregator」。1984 年，Terregator 是最早為實驗室外移動所設計的機器人之一，可以在卡內基美隆大學校園裡，以每小時幾英里的速度行進，繼 Terregator 後，大幅改裝過的麵包車「NavLab」在 1986 年出現，這是首批上路的全電腦控制車之一。在國家機器人工程中心前門外還有另一個著名的前身：一輛載滿電腦的特製雪佛蘭 Tahoe，點綴著外觀疑似 Uber 自動駕駛車車頂感測器的早期版本，這個機器人叫「Boss」，曾贏得 2007 年美國國防高等研究計劃署的城市駕駛比賽，那是自動駕駛車史上的重要一刻，證明自動駕駛車能在正常交通中行駛。要不了幾年，Google 就開始進行自動駕駛車道路實測。

「人類是有認知能力與感受的生物，能夠理解推論，並採取行動。而自動駕駛車只是依照程式設計，在特定情境中作出特定動作罷了。」

這三個卡內基美隆大學的機器人顯示出無人駕駛車演進過程有多麼緩慢，時至今日，雖然系統的軟硬體已獲得提升，卻仍無法像人類一樣充分理解這個包羅萬象的世界，我在國家機器人工程中心實驗室，採訪了帶領研發 Terregator、第一代 NavLab、Boss 的卡內基美隆大學教授維塔可（William “Red” Whittaker）。他認為，Uber 提供這項新服務並不代表技術已 完善，維塔可表示：「當然還沒解決，特殊情境的問題還沒解決。」

待解決的特殊情境多得很，諸如感測器因天氣惡劣、陽光強烈、障礙物而失靈損壞，以及不可避免的軟硬體故障，更重要的是特殊情境需要解決未知問題，程式不可能把每個想像得到的情境都編寫進去，因此到某個程度，就只能信任系統能運用不論什麼智慧都好，應付任何面臨的情境，實在難教人放心，尤其是即使小如把紙袋當成巨石的誤判，都可能造成車輛採取不必要的危險反應。

過去幾年的長足進展不言而喻，特別是電腦視覺和機器學習進步到自動駕駛車能更充分利用行車紀錄，灌進系統的範例夠多的話，程式不只能偵測到障礙物，還能很精確地辨別遇上的是行人、單車騎士或亂跑的鵝。

但特殊情境應變仍然很重要，國家機器人工程中心的機器人專家赫曼（Herman）在印尼長大，卡內基美隆大學求學，開發了國防、農礦用的自動化車輛。他相信自動駕駛車會到來，但也指出 Uber 計劃的一些實際問題。他說：「網路瀏覽器或電腦當機的話，雖然很討人厭，不過問題不大，但若在六線道高速公路上，有一輛開在中間車道的自動駕駛車自顧自地要左轉，接下來會發生什麼事可想而知。這還只是系統對方向盤下錯一道指令而已。」

赫曼預見的另一個問題是這項技術普及後的情況，路上有幾輛無人駕駛車還行，但幾十輛？或甚至幾百輛呢？ Uber 自動駕駛車的車頂雷射掃描儀可能會相互干擾，何況這麼多車若跟雲端連線，需要的頻寬根本是天文數字，他指出，即使小如感測器上的灰塵都可能引起問題。赫曼表示：「這其中最要緊，也愈

如果需要，Uber 會監控每輛車。

來愈多研究投入的，莫過於如何驗證及測試自駕系統的安全性。」

學開車

為了解第一手觀點，我橫越市區去採訪實際開發自動駕駛車的研究人員，拉吉酷馬（Raj Rajkumar）在卡內基美隆大學機器人系主持通用汽車贊助的實驗室，在瞬息萬變的無人駕駛車研究界（往往由矽谷的人主導），拉吉酷馬可能看上去有點老派。採訪當天他穿著灰色西裝在辦公室跟我碰面後，帶我去地下車庫，看他正在做的一輛凱迪拉克原型，這輛車裝有許多類似 Uber 上的感測器，不過小得多也隱密得多，因此外型看來與普通車無異，對自己在提升無人駕駛車實用性上的成就，拉吉酷馬感到自豪之餘，也警告 Uber 計程車可能引起不切實際的期望。他直言：「離程式取代司機還早得很。我想大家應該先靜觀其變。」

除了車用軟體的可靠性，拉吉酷馬也擔心無人駕駛車可能遭駭客攻擊，他說：「大家都知道尼斯的恐怖攻擊中，恐怖份子開車輾過好幾百人，想像一下，要是那車沒人駕駛呢？」Uber 表示對此審慎以對，最近已在團隊中加入兩名車用電腦的資安專家，拉吉酷馬還警告說，要提升電腦對真實世界的理解能力，仍需根本上的進展，他說明：「人類是有認知能力與感受的生物，能夠理解推論，並採取行動。而自動駕駛車只是依照程式設計，在特定情境中作出特定動作罷了。」

換句話說，我在 Uber 自動駕駛車後座看到的彩色畫面，是以一種簡化且奇異的方式所理解的世界，系統即使能幾乎分毫不差地顯示物件位置，但卻無法理解這些物件是什

Uber 自動駕駛車裝載各式各樣的感測器。

麼或可能做什麼，聽起來或許沒什麼，但舉一個明顯的例子，當我們看到路上有玩具時，會因此想到附近有小孩，而作出反應。拉吉酷馬說：「另一個棘手的點是，Uber 主要是在城市和近郊跑，這些地方往往更多意外狀況會發生。」

此外，一旦 Uber 試辦自駕計程車服務出了狀況，可能會連累整個業界。今年春天，一輛設定自動駕駛模式的特斯拉，因為沒有偵測到前方的大卡車，而在佛羅里達州高速公路上釀成第一起自駕系統相關的死亡車禍，當時已引起安全疑憂。太躁進地推廣任何技術，即使是以道路安全為目標的技術，都很容易引發後座力，麻省理工學院的凱斯指出，「雖然 Uber 成功地打響這項技術的突破性，以現實來說，自動駕駛仍然遙不可及，新技術需要仰靠良好的口碑建立消費者接受度，反之亦然，若這種技術造成慘重的車禍，而遭到主管機關管制，肯定會澆熄大眾的熱情。」

我親自體驗過這項技術的局限性，就在試乘 Uber 自動駕駛車的途中，我受邀坐上駕駛座的不久後，我按下自動駕駛系統啟動按鍵，他們告訴我只要轉動方向盤、輕踩踏板或按一個紅色大按鈕，就可以隨時解除自駕模式。就像先前一樣，車子很平順地行駛，但坐在副駕駛座的工程師變得十分緊張，讓我不注意也難。隨後，車上開上一座橋，我們塞在車陣中時，當對向有車開始靠近我們，我這輛車的方向盤居然緩緩向左轉，預備要跨進對向車道，工程師見狀大叫：「快抓方向盤！」

也許這只是一個程式上的錯誤，或者這輛車的感測器被橋樑兩側的空曠一片所混淆，無論如何，我馬上照辦。

奈特（Will Knight）是麻省理工學院技術評論的人工智慧和機器人資深編輯。9 / 10 月號曾刊載他的作品「人工智慧的語言問題」。

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