COMMENT

DRIVING MISS DAISY: AN AUTONOMOUS CHAUFFEUR SYSTEM*

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I. INTRODUCTION[1]

Imagine you are sitting in your car on your way to work in the morning. Except, instead of driving twenty miles per hour with an infinite number of brake lights in front of you, imagine you are sipping your coffee while flipping through today's newspaper, still in the driver's seat, while your car is chauffeuring you sixty miles per hour down the highway. When you arrive at work, you step out of your car in front of the office and send your car to go park itself. Upon leaving work at the end of the day, you call your car from your cell phone, and it arrives just at the perfect time to pick you up. You start to doze off on the way home, knowing your car is in complete control, but you are rudely awakened when your car smashes into the car in front of it. Suddenly, your pleasant daydream has become a nightmare.

Although autonomous vehicles are designed to be crash-less,[2] accidents will happen.[3] When they do, there are many legal questions that will have to be answered.[4] Are you, as the operator of your vehicle, negligent for falling asleep? Could you be held criminally liable if your vehicle violates the rules of the road? Is the manufacturer of the autonomous technology liable for a product defect or improper warning that results in an accident? Is it possible that an unknown third party hacked into your vehicle's system and purposely caused the collision?

Autonomous vehicles are arriving soon on the consumer market, bringing a variety of legal issues with them.[5] Three states—California, Florida, and Nevada—have attempted to

1. In the 1989 film, *Driving Miss Daisy*, the son of an elderly woman who can no longer drive hires Hoke to be her chauffeur. DRIVING MISS DAISY (Warner Bros. 1989). The autonomous cars of the future will serve as virtual chauffeurs, and while they may not provide the same companionship as Hoke, they have the potential to provide great societal benefits. *See infra* Part II (discussing the potential safety, efficiency, and mobility benefits).

2. KPMG & CTR. FOR AUTOMOTIVE RESEARCH, SELF-DRIVING CARS: THE NEXT REVOLUTION 25 (2012), *available at* http://www.cargroup.org/assets/files/self_driving_ cars.pdf; *see also* John Maddox, Nat'l Highway Traffic Safety Admin., Address at the Congressional Robotics Caucus: Improving Driving Safety Through Automation (July 25, 2012).

3. *See* Sven A. Beiker, *Legal Aspects of Autonomous Driving*, 52 SANTA CLARA L. REV. 1145, 1152 (2012) ("As the [autonomous] vehicle navigates itself through traffic, it makes 'mission-critical' decisions, which, in a narrow range of circumstances, can and will contribute to accidents.").

4. *See infra* Part III (discussing the potential legal ramifications of accidents caused by autonomous vehicles).

5. *See* Eric Mayne, *Autonomous Vehicles Close to Reality*, WARD'S AUTO WORLD, Nov. 2008, at 22, 22 ("In five to seven years, expect to see autonomous vehicles capable of navigating freeways . . . ."); Alex Wright, *Automotive Autonomy*, COMM. ACM, July 2011, at 16, 16 ("Most analysts agree that commercially viable self-driving cars remain at least a decade away, but the vision is finally coming closer to reality . . . ."); *infra* Part III (discussing potential legal issues).

resolve some of the issues by enacting legislation relating to autonomous cars,[6] and other states have bills in committee.[7] However, as they are written today, the three enacted laws will prove inadequate when autonomous vehicles are sold on the consumer market because they leave open many questions regarding civil and criminal liability.[8] To further the intended benefits of autonomous vehicle technology, proper regulations should provide legal immunity for autonomous vehicle manufacturers, require data securitization measures for the vehicles, uniformly define who is an "operator" of an autonomous vehicle, and encourage the federal government to create uniform preemption regulations.[9]

This Comment begins with a survey of the current driver-assistance technologies and in-progress autonomous vehicles. Part III analyzes many of the legal issues surrounding autonomous vehicles, including issues of both civil and criminal liability.[10] Finally, Part IV suggests that appropriate regulations will be instrumental in ensuring that autonomous vehicles reach their maximum potential of improving safety, efficiency, and mobility.

II. BACKGROUND

The self-driving cars portrayed in sci-fi flicks such as *I, Robot* and *Minority Report* are becoming a reality.[11] Presently, some cars that are marketed and driven daily are already equipped with a variety of driver-assistance technologies.[12] These

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6. *See* CAL. VEH. CODE § 38750 (West Supp. 2013); FLA. STAT. ANN. §§ 316.85–316.86, 319.145 (West Supp. 2013); NEV. ADMIN. CODE § 482A.010 (2012).

7. *See, e.g.*, H.B. 2238, 26th Leg., Reg. Sess. (Haw. 2012) (requiring the director of transportation to adopt rules "providing for the operation of autonomous motor vehicles on highways"); Gen. Assemb. 2757, 215th Leg., Reg. Sess. (N.J. 2012) (directing the Motor Vehicle Commission to adopt regulations for autonomous vehicles); H.B. 3007, 53d Leg., 2d Sess. (Okla. 2012) (ordering the Department of Public Safety to "adopt rules authorizing the operation of autonomous vehicles on highways" in Oklahoma). These bills have not yet successfully been enacted into law.

8. *Infra* Part III.

9. *Infra* Part IV.

10. While this Comment discusses a breadth of issues, there are many more unsolved questions that are beyond the scope of this Comment and are left unexplored.

11. I, ROBOT (Twentieth Century Fox 2004); MINORITY REPORT (Twentieth Century Fox 2002); *supra* note 5.

12. *See* Matthew Michaels Moore & Beverly Lu, Autonomous Vehicles for Personal Transport: A Technology Assessment 8 tbl.1 (June 2, 2011) (unpublished manuscript) (on file with Author) (providing "a small sampling of known options packages obtainable . . . for purchase in 2011 that include one or more" type of autonomous technology); *see also* Larry Carley, *Active Safety Technology: Adaptive Cruise Control, Lane Departure Warning & Collision Mitigation Braking*, IMPORT CAR (June 16, 2009),

features, while sometimes referred to by different terms, include: Adaptive Cruise Control, Lane-Keeping Systems, Collision Mitigation Braking, Autonomous Parallel Parking, Blind Spot Detection, Autonomous Emergency Steering, and Vehicle-to-Vehicle Communication.[13] As these technologies have become more prevalent, car manufacturers and software companies have begun to combine them in an attempt to create a fully autonomous vehicle.[14] This Section will discuss each of the systems named above and explore the approaches that various car manufactures and companies have taken.

A. Driver-Assistance Technology

In 1995, Mitsubishi introduced the first Adaptive Cruise Control (ACC) system, calling it the Preview Distance Control system.[15] ACC systems, like the Preview Distance Control System, maintain a constant speed set by the driver and monitor the distance between the driver's vehicle and the vehicle immediately in front.[16] If the distance between the two vehicles becomes less than the minimum distance set by the driver, ACC adjusts the speed using the vehicle's throttle and braking

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http://www.import-car.com/Article/58867/active_safety_technology_adaptive_cruise_control_lane_departure_warning__collision_mitigation_braking.aspx ("Today's [driver-assistance systems] do not yet make steering corrections or undertake evasive steering maneuvers to avoid accidents, but the technology to do so is already here.").

13. Andrew P. Garza, Note, *"Look Ma, No Hands!": Wrinkles and Wrecks in the Age of Autonomous Vehicles*, 46 NEW ENG. L. REV. 581, 584–86 (2012) (describing Adaptive Cruise Control, Lane-Keeping Systems, and Collision Mitigation Braking); Subir Biswas, Raymond Tatchikou & Francois Dion, *Vehicle-to-Vehicle Wireless Communication Protocols for Enhancing Highway Traffic Safety*, IEEE COMM. MAG., Jan. 2006, at 74, 74 (discussing the benefits of Vehicle-to-Vehicle Communication); Hans Greimel, *Nissan Debuts Next-Generation Steering*, AUTOMOTIVE NEWS, Oct. 22, 2012, at 10, 10 (describing Nissan's Autonomous Emergency Steering); Tim Moran, *Curb Your Car, Please: Parking Is Easy When the Valet Is a Computer*, N.Y. TIMES, Nov. 5, 2006, at N2 [hereinafter Moran, *Curb Your Car, Please*] (describing Autonomous Parallel Parking systems); Tim Moran, *Radar Brings Vision to Cars' Blind Spots*, N.Y. TIMES, Feb. 2, 2004, at D13 [hereinafter Moran, *Radar Brings Vision to Cars' Blind Spots*] (describing Blind Spot Detection).

14. *See* Garza, *supra* note 13, at 587 ("The autonomous car has technology similar to [Advanced Vehicle Safety Technologies] that are presently commercially available; the difference is that it combines them all into one package . . . ."); *see also* Henry Fountain, *Yes, Driverless Cars Know the Way to San Jose*, N.Y. TIMES, Oct. 28, 2012, at AU1 ("'We're taking the adaptive cruise control and the lane-keeping and bringing them together,' Mr. Hernandez [principal engineer at the Volkswagen Group's Electronics Research Laboratory] said.").

15. José E. Naranjo et al., *Using Fuzzy Logic in Automated Vehicle Control*, IEEE INTELLIGENT SYSTEMS, Jan.–Feb. 2007, at 36, 40.

16. *Look, No Hands*, ECONOMIST, Sept. 1, 2012, at 17, 17; Naranjo et al., *supra* note 15, at 40.

systems.[17] Depending on the manufacturer, ACC uses radars and lasers to monitor the distance.[18] Further, ACC operates only at speeds above 25 miles per hour.[19] Although ACC was originally introduced only for high-end vehicles, "[a]lmost all car manufacturers now offer ACC systems," and the technology has been described as "[t]he most under-hyped, but most important, technology since seat belts."[20] The price varies depending on the manufacturer, with some manufacturers charging as little as $925 for the addition of ACC technology.[21]

Lane-Keeping Systems (LKS) use cameras to monitor the lane markers on a road and an alert that notifies the driver if the vehicle drifts out of the lane or if the driver fails to use the turn signal.[22] Certain types of LKS notify the driver with both an auditory and visual warning, while others provide "resistance to turning the steering wheel" in an attempt to keep the car in the lane.[23] The notification and resistance alert systems are a significant part of LKS, as they are designed to prevent the 25% of accidents caused by driver distraction.[24]

Collision Mitigation Braking (CMB) systems use cameras or radars to monitor the proximity of the preceding vehicle, much

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17. Carley, *supra* note 12.

18. *Id.*

19. *See* Naranjo et al., *supra* note 15, at 40 ("ACC systems don't work at speeds lower than 40 kmh [24.85 mph] . . . ."); *see also* H.M. Jagtman & E. Wiersma, *Driving with Adaptive Cruise Control in the Real World*, 16 INT'L CO-OPERATION ON THEORIES & CONCEPTS IN TRAFFIC SAFETY WORKSHOP 1, 2 (2003) ("[T]he system switches off when the speed drops under 40 km/h [24.85 mph] . . . .").

20. Naranjo et al., *supra* note 15, at 40; *see* Garza, *supra* note 13, at 584–85 (quoting Robert Scoble, *The Most Under-Hyped, but Most Important, Technology Since Seat Belts*, SCOBLEIZER (Jan. 3, 2010), http://scobleizer.com/2010/01/03/the-most-under-hyped-but-most-important-technology-since-seat-belts). *But see* Jagtman & Wiersma, *supra* note 19, at 1–3 (discussing negative real world implications arising from current ACC technology).

21. *See* Moore & Lu, *supra* note 12, at 8 tbl.1 (listing the 2011 price for the Adaptive Cruise Control Group on the Dodge Charger Rallye as $925).

22. Carley, *supra* note 12.

23. *Id.*; Moore & Lu, *supra* note 12, at 7.

24. Mohan Manubhai Trivedi, Tarak Gandhi & Joel McCall, *Looking-In and Looking-Out of a Vehicle: Computer-Vision-Based Enhanced Vehicle Safety*, 8 IEEE TRANSACTIONS ON INTELLIGENT TRANSP. SYSTEMS 108, 109 (Mar. 2007) (citing the Traffic Safety Facts in 2003 compiled by the National Highway Traffic Safety Administration (NHTSA)); Moore & Lu, *supra* note 12, at 6 (noting that LKS arguably provides "a perfectly safe environment in which to begin using one's cellular phone"). In 2009, NHTSA conducted another study and found that 20% of injury crashes that year resulted from distracted driving. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., TRAFFIC SAFETY FACTS RESEARCH NOTE: DISTRACTED DRIVING 2009, at 1 (Sept. 2010), *available at* http://www.distraction.gov/research/pdf-files/distracted-driving-2009.pdf. The report explains that the recently revised definition of the term "distracted driving" may account for the 5% decrease in the number of injury crashes. *Id.*

like ACC systems.[25] CMB uses a series of steps to apply the vehicle's brakes to prevent a collision.[26] One of the most advanced versions is "City Safety," Volvo's fully automatic braking system.[27] City Safety first audibly and visually warns the driver if the vehicle is approaching another vehicle too quickly.[28] Second, the system pre-loads the brakes to assist the driver in braking.[29] Finally, if the driver fails to react, City Safety fully and automatically applies the brakes, causing the car to come to a complete stop.[30] However, City Safety does not work at speeds above 18 miles per hour.[31]

A second CMB system, Mercedes' PRE-SAFE Braking, follows the same basic steps as City Safety.[32] However, PRE-SAFE Braking determines what step to take not based on the decreasing distance between the vehicles, but on the number of seconds before impact: the warning comes on 2.6 seconds before impact, the brakes are preloaded 1.6 seconds before impact, and the brakes are fully applied 0.6 seconds before impact.[33] Impressively, PRE-SAFE Braking works when the vehicle is traveling at speeds up to 43 miles per hour, which is more than double the speed allowed by City Safety.[34] Other CMB systems follow the same steps, but only apply about 40% of the full braking power in the final step.[35] These systems do not have operating speed limitations, and some also tighten the seat belts in preparation for a collision.[36]

Autonomous Parallel-Parking (APP) systems parallel park a vehicle at the push of a button.[37] Each capable vehicle is equipped

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25. Garza, *supra* note 13, at 584–86; Carley, *supra* note 12. Not all CMB systems use cameras and radars; some systems rely on an infrared laser sensor (LIDAR) to actively monitor the roadway and distance between cars. Martin Distner et al., *City Safety – A System Addressing Rear-End Collisions at Low Speeds*, *in* 21ST INTERNATIONAL TECHNICAL CONFERENCE ON THE ENHANCED SAFETY OF VEHICLES, at 2 (NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., Paper No. 09-0371-O, June 2009); Carley, *supra* note 12.

26. Garza, *supra* note 13, at 586; Carley, *supra* note 12.

27. Carley, *supra* note 12.

28. *Id.*

29. *Id.*; *see also* Distner et al., *supra* note 25, at 2 ("If the vehicle in front suddenly brakes and City Safety determines that a collision is likely, the brakes are pre-charged.").

30. Carley, *supra* note 12; Distner et al., *supra* note 25, at 2–3.

31. Carley, *supra* note 12.

32. *See id.*

33. *Id.*

34. *Id.*

35. *Id.*

36. *Id.*

37. Moran, *Curb Your Car, Please*, *supra* note 13. The current technology, first introduced on the 2007 Lexus LS 460, does not operate completely autonomously: the driver is still required to control the speed of the car using the brakes. *Id.*

with sensors in the front and the back, as well as a backup camera that displays video to the driver.[38] As the vehicle approaches an empty parking space, APP systems direct the steering wheel to park the car.[39] Some systems use simultaneous localization and map-learning to find a parking spot and path planning to find a feasible way to park the car.[40] The systems then park the vehicle by following the planned path.[41] In other APP systems, the driver must still participate in parking, for example, by controlling the speed of the car using the gas pedal and the brakes.[42] APP systems can be intricate, because they have to detect vehicles and people near the parking space and "plan complex maneuvers to fit in the space."[43] When APP systems were first introduced, they increased a vehicle's purchase price by approximately $4,000; however, APP systems are now found for as low as a $395 increase in the retail price of the vehicle.[44]

In addition to APP systems, some manufacturers have developed other autonomous parking systems. Nissan, for example, has a self-parking system that allows the driver to exit the vehicle and then use her smartphone to tell the car to find a parking spot.[45] The car later meets the driver at a specified location.[46] Ford has also developed technology that

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38. *See id.* ("The automated parking system . . . uses information from sensors mounted on the front and rear bumpers, along with the display of the rearview camera, to steer the car into a parking space.").

39. *Id.*

40. Johan Jernström, Autonomous Parallel Parking 3–4 (May 2008) (unpublished Master Thesis, Lund University, Sweden) (on file with Lund University Libraries).

41. *Id.*

42. Arne Suppé, Luis E. Navarro-Serment & Aaron Steinfeld, *Semi-Autonomous Virtual Valet Parking*, *in* AUTOMOTIVEUI 2010: SECOND INTERNATIONAL CONFERENCE ON AUTOMOTIVE USER INTERFACES AND INTERACTIVE VEHICULAR APPLICATIONS 139, 139 (2010) ("It is worth noting that sensitivity to liability and safety issues has led to semi-autonomous parallel parking solutions, rather than the fully autonomous method demonstrated . . . .").

43. NIDHI KALRA, JAMES ANDERSON & MARTIN WACHS, CAL. PARTNERS FOR ADVANCED TRANSIT & HIGHWAYS, LIABILITY AND REGULATION OF AUTONOMOUS VEHICLE TECHNOLOGIES 10 (2009).

44. *See* Moran, *Curb Your Car, Please*, *supra* note 13 ("On the regular-wheelbase LS 460, the price is slightly more than $4,000 . . . ."); *see also* Suzanne Kane, *2012 Family Cars with Self-Parking Technology*, CAR CONNECTION (Oct. 27, 2011), http://www.thecarconnection.com/news/1067819_2012-family-cars-with-self-parking-technology (listing the prices as low as $395 for Active Park Assist on a 2012 Ford Escape Limited and as high as $970 for high-end models such as the Parktronic system on the 2012 Mercedes-Benz C-Class).

45. Lindsay Chappell, *Nissan Unveils Driverless Car Technologies*, AUTOMOTIVE NEWS, Oct. 8, 2012, at 14, 14.

46. *Id.*

allows a vehicle not only to parallel park itself, but to park perpendicularly as well.[47]

Drivers today are more interested in Blind Spot Detection (BSD) systems than any other autonomous feature.[48] One report suggests that BSD technology "will be included in 20 million vehicles, or 25 percent of the world's total" by 2016.[49] The vehicles are fitted with radar sensors and cameras that monitor neighboring lanes and alert the driver when another vehicle is driving in its blind spot.[50] The type of alert depends on the manufacturer of the BSD system; for instance, Ford and Mercedes-Benz both use a system that illuminates a light on the side view mirrors, but Mercedes-Benz's system changes the color of the light and sounds a tone if the driver activates his turn signal despite the initial warning light.[51] When BSD is used in combination with a Lane-Keeping System (LKS), a distracted driver will be alerted in numerous ways to regain control of her vehicle to avoid a collision if her vehicle is drifting towards another vehicle located in her blind spot.[52]

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47. *Ford Develops 'Traffic Jam Assist' and New Parking Technology to Help Address Future Mobility Challenges*, FORD MOTOR CO. (June 26, 2012), http://corporate.ford.com/our-company/investors/investor-news-detail/pr-ford-develops-26lsquotraffic-jam-36722.

48. *See* Lee Hawkins, *The Skinny on Self-Parking*, WALL ST. J. (Mar. 18, 2010, 7:27 PM), http://online.wsj.com/article/SB10001424052748703734504575125883649914708.html ("The [autonomous] feature with the highest interest? Blind-spot detection."); *see also* Press Release, J.D. Power & Associates, 2009 U.S. Automotive Emerging Technologies Study (June 3, 2009), *available at* http://content4.businesscenter.jdpower.com/JDPAContent/CorpComm/News/content/Releases/pdf/2009098.pdf (showing that blind spot detection has the highest interest).

49. Danny King, *Increase Seen for Blind-Spot Detection Systems*, AUTOOBSERVER, (Mar. 21, 2011), http://www.autoobserver.com/2011/03/increase-seen-for-blind-spot-detection-systems.html.

50. *See* Moran, *Radar Brings Vision to Cars' Blind Spots*, *supra* note 13 ("Two [sensors] are used—one on each side of the car . . . . When a car or truck comes close enough . . . the system alerts the driver . . . .").

51. *Compare Blind Spot Information System (BLIS) with Cross-Traffic Alert*, FORD MOTOR CO. (July 2012), http://corporate.ford.com/doc/BLIS.pdf (discussing Ford's system), *and Blind Spot Object Detection Systems*, I-CAR ADVANTAGE ONLINE 2 (Oct. 30, 2009), http://www.i-car.com/pdf/advantage/online/2009/101309.pdf (describing Mercedes-Benz's system), *with* Jerry Hirsch, *Los Angeles Auto Show*, L.A. TIMES, Nov. 25, 2012, at B1 ("Honda's LaneWatch system uses a camera mounted on the passenger mirror to provide an enhanced view of the passenger-side roadway on the dashboard screen.").

52. *See supra* notes 22–24 and accompanying text (discussing Lane Keeping Systems); *see also* Andrew Dankers et al., *Driver Assistance: Contemporary Road Safety*, 2003 AUSTRALASIAN CONF. ON ROBOTICS & AUTOMATION 1, 7 ("[T]he warning signals are combined to most effectively alert the driver as to what sort of warning is occurring and the direction from which the warning originated from [sic], so that reaction times are reduced. . . . [W]here the system detects driver distraction, it is handled by first warning the driver . . . .").

So far, Nissan is the only manufacturer to develop an Autonomous Emergency Steering (AES) system.[53] However, there is no reason to believe other manufacturers cannot produce or use this software.[54] The Nissan Leaf, which is the first vehicle to carry this technology, is fitted with sensors—"five laser scanners, three millimeter-wave radars and one camera"—that scan the area around the vehicle, looking for "escape zones" that the vehicle could move into in an attempt to avoid a crash.[55] In event of a possible collision, the system sounds a warning to the driver before steering into a safe zone.[56] If there are no safe zones around the vehicle, the system uses Collision Mitigation Braking (CMB) as a backup.[57] Currently, the system works at speeds less than 40 mph when searching for pedestrians and speeds less than 50 mph when monitoring for stationary vehicles[58] but is not yet available for consumer use.[59]

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53. *See* Greimel, *supra* note 13, at 10 (describing the technology as "the world's first"); Richard Yarrow, *Nissan's Autonomous Emergency Steer Tech*, AUTO EXPRESS (Oct. 18, 2012, 12:30 PM), http://www.autoexpress.co.uk/nissan/leaf/60847/nissans-autonomous-emergency-steer-tech. It is interesting that more manufacturers have not produced Automated Steering Systems. One source notes that "[o]ne of the key goals of an automated vehicle is the ability to perform automatic steering control." ÜMIT ÖZGÜNER, TANKUT ACARMAN & KEITH REDMILL, AUTONOMOUS GROUND VEHICLES 167 (2011).

54. *See* Yarrow, *supra* note 53 ("AES would work on any car equipped with the right sensors and software . . . ."). In fact, this software is very similar to MIT's semiautonomous collision avoidance system. Paul Ridden, *Semiautonomous Driving System Takes Over When Drivers Make Mistakes*, GIZMAG (July 16, 2012), http://www.gizmag.com/mit-semiautonomous-vehicle-safety-system/23330/ (noting that MIT's system "take[s] control of the vehicle, bring[s] it back within a calculated safe zone, and then hand[s] control back over to the driver").

55. Greimel, *supra* note 13, at 10; *see* Yarrow, *supra* note 53 ("The technology is a world first and is being demonstrated on a Nissan Leaf.").

56. Viknesh Vijayenthiran, *Watch Nissan's New Autonomous Safety System in Action*, WASH. POST (Oct. 17, 2012), http://www.washingtonpost.com/cars/watch-nissans-new-autonomous-safety-system-in-action-video/2012/10/17/5061beb2-184a-11e2-a346-f24efc680b8d_story.html.

57. *See* Yarrow, *supra* note 53 ("If no safe zone is detected the accident will still happen but be mitigated through braking."); *see also* Vijayenthiran, *supra* note 56 ("[T]he new system is designed to help avoid vehicle accidents by applying automatic braking and automatic steering in situations where a collision is imminent and simply applying the brakes may not be affective [sic].").

58. Yarrow, *supra* note 53.

59. *See* Greimel, *supra* note 13, at 10 ("The so-called autonomous emergency steering system isn't quite ready for market."); K.C. Colwell, *Nissan Introduces Autonomous Emergency Steering*, CAR & DRIVER BLOG (Oct. 19, 2012, 1:03 PM), http://blog.caranddriver.com/nissan-introduces-autonomous-emergency-steering-like-being-chauffeured-from-the-drivers-seat/ ("[T]he system still is under development and a few years from production . . . ."). Because the system has not been produced for the market, it is not currently priced. *See* Colwell, *supra* (noting that there is "no defined rollout plan" for the Autonomous Emergency Steering system, as it is still under development).

Vehicle-to-Vehicle (V2V) communication can be used to "improve highway safety by avoiding chain collisions."[60] Essentially, V2V communication allows a vehicle to wirelessly communicate an emergency situation through warnings to other vehicles that provide "the geographical location, speed, acceleration and moving direction" of the initiating vehicle.[61] If a vehicle is broken down on the side of the road, for instance, it could communicate with approaching cars a few miles in advance to give them warning of a potential traffic stall.[62] V2V communication will also allow "driverless cars approaching a junction [to] co-ordinate their movements to keep traffic flowing smoothly, rather than having to stop and take turns."[63] The benefits of V2V communication, however, cannot be fully realized until a large number of vehicles are equipped with the software.[64]

The U.S. Department of Transportation is currently exploring V2V communication[65] and has installed the technology in 3,000 vehicles in six different cities, including Ann Arbor, Michigan, as part of the Safety Pilot Model Deployment program.[66] The V2V technologies included in the Pilot program are "emergency brake-light warning, forward-collision warning, intersection movement assist, blind-spot and lane-change warning, do-not-pass warning, and left-turn assist."[67] So far, users have viewed the technology favorably, with "[o]ver 90 percent of the respondents indicat[ing] that they would like to have the V2V safety features in their vehicles," and 58 percent stating they "would be willing to pay up to $250" for the technology.[68]

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60. Biswas, Tatchikou & Dion, *supra* note 13, at 76.

61. Xue Yang et al., *A Vehicle-to-Vehicle Communication Protocol for Cooperative Collision Warning*, 2004 INT'L CONF. ON MOBILE & UBIQUITOUS SYSTEMS 114, 115.

62. Viknesh Vijayenthiran, *Volvo Outlines Benefits of Car 2 Car Communication*, MOTOR AUTHORITY (Oct. 22, 2012), http://www.motorauthority.com/news/1079974_volvo-outlines-benefits-of-car-2-car-communication.

63. *Look, No Hands*, *supra* note 16, at 19.

64. *See* Ron Schneiderman, *Car Makers See Opportunities in Infotainment, Driver-Assistance Systems*, IEEE SIGNAL PROCESSING MAG, Jan. 2013, at 11, 15 (suggesting that "there needs to be a critical mass of V2V-equipped [vehicles] on the road at the same time" for the system to be effective).

65. KALRA, ANDERSON & WACHS, *supra* note 43, at 15 ("[T]he US DOT's IntelliDrive℠ program aims to enable vehicles to identify roadway threats and communicate these threats to other vehicles over a wireless network . . . .").

66. *Safety Pilot,* RES. & INNOVATIVE TECH. ADMIN., U.S. DEP'T OF TRANSP., http://www.its.dot.gov/safety_pilot/index.htm (last updated July 18, 2013).

67. *Id.*

68. *Id.*

V2V communication can also allow cars to travel closely together in platoons.[69] This system has attracted the attention of American researchers, like the National Automated Highway System Consortium,[70] as well as the European researchers who created the Safe Road Trains for the Environment (SARTRE) project in 2009.[71] The SARTRE project's focus was to create a platoon of in-sync vehicles trailing behind a human-operated vehicle.[72] The vehicles are individually programmed to maintain a set distance behind the vehicle in front of them while being electronically tied to the lateral location of the leader vehicle.[73] Once a car decides to join the platoon, it sends an electronic request and waits for confirmation from the lead vehicle before approaching the platoon, "put[ting] the car into semiautomatic mode," and waiting for the automatic system to take over.[74] The significance of the SARTRE project is that the platooned vehicles did not undergo huge technological transformations; rather, the project made use of already existing Adaptive Cruise Control and Lane-Keeping systems.[75] This serves as a potentially more cost-effective strategy for bringing fully autonomous vehicles to the consumer market.[76]

B. *Autonomous Vehicles*

Google, a company known for its online search engine, announced in 2010 that it was working on a self-driving-car project.[77] Google began the project by fitting several Toyota Priuses with sensors, cameras, lasers, and computers that help the vehicles assess their surroundings and drive along the road

69. *See* Tyler C. Folsom, *Energy and Autonomous Urban Land Vehicles*, IEEE TECH. & SOC'Y MAG., Summer 2012, at 29, 31 ("[T]he National Automated Highway System Consortium (NAHSC) has demonstrated a platoon of eight cars driving automatically with a 3-m (10-ft) gap between vehicles.").

70. *Id.*

71. Erik Coelingh & Stefan Solyom, *All Aboard the Robotic Road Train*, IEEE SPECTRUM, Nov. 2012, at 34, 37–38.

72. *Id.* at 38; *see also* Wright, *supra* note 5, at 17 (describing the platoon as having "a lead car operated by a human driver").

73. Coelingh & Solyom, *supra* note 71, at 38.

74. *Id.*

75. *See id.* at 38–39 ("[T]oday's vehicles already have most of the technology they need to [be autonomous] . . . .").

76. Wright, *supra* note 5, at 17–18.

77. *See* Fountain, *supra* note 14 ("Since the project was first widely publicized more than two years ago . . . ."); John Markoff, *Look Officer, No Hands: Google Car Drives Itself*, N.Y. TIMES, Oct. 10, 2010, at A1 ("The Google research program using artificial intelligence to revolutionize the automobile is proof that the company's ambitions reach beyond the search engine business."); *see also What We're Driving At*, GOOGLE BLOG (Oct. 9, 2010), http://googleblog.blogspot.com/2010/10/what-were-driving-at.html.

without human intervention.[78] Over the course of the project, Google has added several Lexuses and an Audi TT to its convoy of vehicles, helping to amass over 300,000 autonomously-driven miles.[79] The self-driving cars are able to drive the speed limit, distinguish pedestrians from other roadside objects, and communicate with Google's mapping software to identify changes in the environment, such as construction zones or other road obstructions.[80] The cars also take on human behaviors, like inching forward at a four-way intersection to inform other drivers they plan to advance into the intersection.[81] Impressively, none of the vehicles have been involved in an accident while driving in autonomous mode.[82]

Google's driverless vehicles still have many issues ahead of them.[83] In a recent interview with National Public Radio, Chris Urmson, an engineer at Google, stated that the vehicles have not yet learned how to drive in reverse.[84] However, Google continues to work on the self-driving car project, but has no current plans to manufacture autonomous cars on its own.[85] Rather, Google intends to work with traditional vehicle manufacturers in developing technology that will put driverless cars on the market.[86]

Although the Google car may be the most well-known self-driving car, many more manufacturers are also in the process of developing autonomous vehicles.[87] Continental plans to test an

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78. *California Moves into the Self-Driving Lane*, WASH. POST, Sept. 26, 2012, at A14; Fountain, *supra* note 14 ("The [lidar] units take so many measurements that, when combined with information from the radar and cameras, a moving map of the car's surroundings can be created in the onboard computer . . . .").

79. *See* Fountain, *supra* note 14 ("[T]he company's driverless cars—earlier-generation Toyota Priuses and the newer Lexuses, recognizable by their spinning, roof-mounted laser range finders—have logged about 300,000 miles on all kinds of roads."); *see also* Markoff, *supra* note 77 ("Google is using six Priuses and an Audi TT in the project.").

80. Fountain, *supra* note 14; John Markoff, *Guided by Computers and Sensors, A Smooth Ride at 60 Miles Per Hour*, N.Y. TIMES, Oct. 10, 2010, at A18; Markoff, *supra* note 77.

81. *Look, No Hands*, *supra* note 16, at 18.

82. *Id.* at 18–19. One vehicle was involved in a fender-bender, although this accident occurred while a human driver was in control of the vehicle. *Id.*

83. *Calif. Greenlights Self-Driving Cars, but Legal Kinks Linger* (NPR radio broadcast Oct. 3, 2012), http://www.npr.org/blogs/alltechconsidered/2012/10/03/162187419/calif-greenlights-self-driving-cars-but-legal-kinks-linger.

84. *Id.*

85. Fountain, *supra* note 14.

86. *Id.*

87. *See* Tom Vanderbilt, *Let the Robot Drive: The Autonomous Car of the Future Is Here*, WIRED MAG., Feb. 2012, at 86, 86 ("[J]ust about every traditional automaker is developing its own self-driving model . . . .").

autonomous vehicle in Nevada and hopes to put fully autonomous vehicles on the roads by 2025.[88] Audi has already produced a TTS that drove itself up Pikes Peak, although Audi's technology is far from being available on the market and is still in a pre-production planning phase.[89] BMW has also manufactured a self-driving car that was able to navigate its way from Munich to Ingolstadt on the Autobahn.[90] Other manufacturers are expanding current technologies to allow vehicles to function semi-autonomously, such as General Motor's Super Cruise, Mercedes-Benz's Advanced Driving Assist, and Ford's Traffic Jam Assist.[91]

Some companies are using driver-assistance technologies to provide otherwise nonfully autonomous vehicles with autonomous capabilities instead of manufacturing fully autonomous vehicles.[92] One example is a subsidiary of Japanese company Komatsu that manufactures self-driving semi-trailer trucks that use V2V communication in combination with sensors and are capable of hauling 300 tonnes of ore.[93] These trucks are currently being used on the site of a fully autonomous "mine of the future" near Perth, Australia.[94] An Italian company, VisLab, also implemented V2V communication in several cars in 2010, when it successfully drove four autonomous vehicles over 8,000 miles from Parma, Italy, to Shanghai, China.[95] The vehicles traveled two at a time, with the first vehicle driving autonomously when possible and communicating a route for the second vehicle to follow through radio broadcasts of GPS coordinates.[96] These vehicles alternated with two others, taking

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88. Michael Vaughan, *Self-Driving Cars on the Road to Reality*, GLOBE & MAIL, Jan. 3, 2013, at D7.

89. Chris Woodyard, *Self-Driving Cars Become More Fact than Fantasy*, USA TODAY, July 10, 2012, at 3B.

90. Vanderbilt, *supra* note 87, at 86.

91. Woodyard, *supra* note 89.

92. *See* Coelingh & Solyom, *supra* note 71, at 36 ("A few years ago, my colleagues and I at Volvo asked ourselves how we could build on our adaptive cruise control system to give a car full autonomy.").

93. *Look, No Hands*, *supra* note 16, at 19.

94. Natalie Stechyson, *Meet a Really Smart Car: It Has No Driver*, GLOBE & MAIL, July 21, 2010, at A2.

95. *See id.* ("As two small cars embark on a journey from Italy to China, they're missing only one thing . . . : drivers."); *see also* Massimo Bertozzi et al., *VIAC Expedition Toward Autonomous Mobility*, IEEE ROBOTICS & AUTOMATION MAG., Sept. 2011, at 120, 120–22 ("[F]our Piaggio Porter Electric Power vans were finally selected for VIAC. . . . [T]he convoy traveled a total distance of more than 13,000 km [8077.83 miles].").

96. Bertozzi et al., *supra* note 95, at 121. There were several times when operators had to take control of the leading vehicle in order to make a decision about driving. *Id.*

turns between recharging and driving, and they even picked up a couple of hitchhikers along their journey![97]

Once fully autonomous vehicles become ubiquitous, their benefits will be massive, touching areas such as safety, efficiency, and mobility.[98] In the U.S. in 2010 there were 2,239,000 injuries and 32,885 fatalities resulting from motor vehicle crashes.[99] Worldwide, in 2002, traffic injuries were the second leading cause of death in persons aged 5–29 years old and the third leading cause of death in persons aged 30–44 years old.[100] In total, driver error causes approximately 95% of accidents in the United States.[101] Autonomous vehicles have the potential to eliminate driver error and thus significantly decrease the number of motor vehicle crashes.[102] Self-driving cars also have the ability to travel closer together, which increases the amount of available highway space and increases fuel efficiency by reducing aerodynamic drag.[103] As a result, congestion may be

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97. *Id.* at 121–22.

98. *See* Beiker, *supra* note 3, at 1149 ("Autonomous vehicles . . . have the potential to vastly improve the quality of personal and commercial transportation in [safety, efficiency, and mobility]."); *see also* Hillary Jeanette Ford, Shared Autonomous Taxis: Implementing an Efficient Alternative to Automobile Dependency 42 (June 2012) (unpublished thesis, Princeton University) ("[A]utonomous vehicles have the potential to reap direct and immediate benefits in the realms of accessibility, safety, and efficiency simply by just replacing the conventional automobile."). Autonomous vehicles also "would mark a sea-change in the role of technology in warfare as the human could potentially be removed from the decisionmaking loop." ANTHONY FINN & STEVE SCHEDING, DEVELOPMENTS AND CHALLENGES FOR AUTONOMOUS UNMANNED VEHICLES 155 (Janusz Kacprzyk & Lakhmi C. Jain eds., 2010).

99. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., TRAFFIC SAFETY FACTS 2010, at 17 (2012), *available at* http://www-nrd.nhtsa.dot.gov/Pubs/811659.pdf. The number of fatalities in the U.S. in 2011 was 21,253. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., TRAFFIC SAFETY FACTS 2011 DATA 12 (2013), *available at* http://www-nrd.nhtsa.dot.gov/Pubs/811827.pdf.

100. WORLD HEALTH ORG., WORLD REPORT ON ROAD TRAFFIC INJURY PREVENTION 4 (2004), *available at* http://whqlibdoc.who.int/publications/2004/9241562609.pdf.

101. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., NATIONAL MOTOR VEHICLE CRASH CAUSATION SURVEY: REPORT TO CONGRESS 25 (2008), *available at* http://www-nrd.nhtsa.dot.gov/Pubs/811059.PDF (attributing 40.6% to recognition errors, such as inadequate surveillance or distractions, 34.1% to decision error, such as aggressive driving or speeding, and 10.3% to performance error, such as overcompensation or poor directional control).

102. Tyler C. Folsom, *Social Ramifications of Autonomous Urban Land Vehicles*, 2011 INST. OF ELECTRICAL & ELECTRONICS ENGINEERS INT'L SYMP. ON TECH. & SOC'Y 1, 2–3 (suggesting that autonomous vehicles "produce a safety advantage of orders of magnitude"); *see also* KPMG & CTR. FOR AUTOMOTIVE RESEARCH, *supra* note 2, at 7 ("The goal is to develop 'crash-less' cars."); Brian Hayes, *Leave the Driving to It*, AM. SCIENTIST, Sept.–Oct. 2011, at 362, 363 ("Taking the controls out of human hands would eliminate several major causes of crashes: drivers who are asleep, inebriated, impatient, inattentive, overconfident, inexperienced.").

103. *See* Folsom, *supra* note 102, at 4 ("Automated transportation allows the safe following distances between vehicles to shrink. . . . This has an effect on highway capacity, increasing it by three to eight times. . . . The power required to move a vehicle is the sum of energy changes needed to overcome rolling resistance (W_R) and aerodynamic drag (W_D) . . . .").

lessened,[104] if not completely eliminated, and individuals will find themselves with extra time and greater fuel efficiency.[105] Lastly, autonomous vehicles may increase the mobility of otherwise unable drivers—such as persons under sixteen years old and the disabled—by providing a self-driving mode of transportation.[106]

III. POTENTIAL LEGAL LIABILITY

Despite their numerous benefits, autonomous technologies and vehicles are largely unregulated.[107] As of today, only three states—Nevada, Florida, and California—have enacted legislation or promulgated regulations relating to autonomous vehicles.[108] Further, many of the regulations concerning today's vehicles assume that a human is driving the vehicle.[109] But when a vehicle is fully autonomous, there may not be a need for a human in the car at all.[110] Therefore, it may be a challenge to determine who, if anyone at all, is the actual operator, which may result in difficulty assigning liability in the event of an accident.[111] This Part will discuss potential civil

104. *See* KPMG & CTR. FOR AUTOMOTIVE RESEARCH, *supra* note 2, at 31 ("Nonrecurrent traffic congestion would be a thing of the past . . . ."). *But see* Bryant Walker Smith, *Managing Autonomous Transportation Demand*, 52 SANTA CLARA L. REV. 1401, 1413 (2012) ("This is the potential paradox of autonomous driving. Highways may carry significantly more vehicles, but average delay during the peak period may not decrease appreciably.").

105. *See* Smith, *supra* note 104, at 1408 ("As a result of congestion in 2010, 'urban Americans' traveled an additional '4.8 billion hours' and 'purchase[d] an extra 1.9 billion gallons of fuel.'" (alteration in original)).

106. Beiker, *supra* note 3, at 1151–52.

107. *See* KALRA, ANDERSON & WACHS, *supra* note 43, at 2.

108. *See* CAL. VEH. CODE § 38750 (West Supp. 2013); FLA. STAT. ANN. §§ 316.85–316.86, 319.145 (West Supp. 2013); NEV. ADMIN. CODE § 482A.010 (2012); *see also* Ryan Holeywell, *6 Questions States Need to Ask About Self-Driving Cars*, GOVERNING (Aug. 16, 2013), http://www.governing.com/blogs/fedwatch/gov-six-questions-that-need-to-be-answered-about-self-driving-cars.html (identifying Nevada, Florida, and California as the only states that have passed autonomous vehicle legislation).

109. *See, e.g.*, CAL. VEH. CODE §§ 305, 470 (West Supp. 2013) ("A 'driver' is a person who drives or is in actual physical control of a vehicle. . . . 'Person' includes a natural person, firm, copartnership, association, limited liability company, or corporation."); NEV. REV. STAT. ANN. § 484A.080 (LexisNexis 2010) ("'Driver' means every person who drives or is in actual physical control of a vehicle."); TEX. TRANSP. CODE ANN. §§ 541.001(1), 541.001(4) (West 1999) ("'Operator' means, as used in reference to a vehicle, a person who drives or has physical control of a vehicle. . . . 'Person' means an individual, firm, partnership, association, or corporation.").

110. *See* Frank Douma & Sarah Aue Palodichuk, *Criminal Liability Issues Created by Autonomous Vehicles*, 52 SANTA CLARA L. REV. 1157, 1160 (2012) ("[T]he autonomous vehicle is so skilled at driving that it functions as a driverless car—with or without passengers.").

111. *Id.* at 1160.

and criminal liability revolving around autonomous vehicles and driver-assistance technology.

A. *Civil Liability*

Currently, civil liability arising from car accidents is based in personal injury tort law.[112] The various theories of liability stem from negligence, strict liability, and products liability.[113] To successfully bring a negligence lawsuit, an injured party must prove that another party failed to take reasonable care in preventing the risk that led to injury.[114] Strict liability, however, can be established without proving fault by showing that the person was engaged in an abnormally dangerous activity.[115] Finally, an injured person may bring a product liability lawsuit alleging a manufacturing defect, a design defect, or a failure to warn.[116]

A determination of who was operating an autonomous vehicle may be critical in assigning liability for a car crash, especially when there is not even a human in the car.[117] The potential parties that could be at fault include: the operator (defined differently in the three states which have currently enacted legislation),[118] the vehicle manufacturer (the manufacturer of the original nonautonomous vehicle),[119] the automator (the modifier of the original vehicle into an autonomous vehicle or the creator of an autonomous vehicle from scratch),[120] and the programmer (the person responsible for creating and coding the autonomous software).[121]

Although all of the aforementioned theories may apply in a lawsuit involving an autonomous vehicle,[122] one article predicts

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112. KALRA, ANDERSON & WACHS, *supra* note 43, at 17.

113. Gary E. Marchant & Rachel A. Lindor, *The Coming Collision Between Autonomous Vehicles and the Liability System*, 52 SANTA CLARA L. REV. 1321, 1323 (2012).

114. RESTATEMENT (SECOND) OF TORTS § 282 (1965).

115. RESTATEMENT (SECOND) OF TORTS § 519 (1977); KALRA, ANDERSON & WACHS, *supra* note 43, at 19; Marchant & Lindor, *supra* note 113, at 1323.

116. RESTATEMENT (THIRD) OF TORTS: PRODUCTS LIABILITY § 1 cmt. a (1998).

117. *See* Marchant & Lindor, *supra* note 113, at 1326–27 ("Autonomous vehicles are likely to change the dynamics of who may be held liable.").

118. *See infra* notes 185–94 and accompanying text (illustrating the liability implications of the differing definitions of "operator").

119. David Pardy, *Licensing Autonomous Cars*, INNOVATION L. BLOG (Oct. 14, 2012), http://innovationlawblog.org/2012/10/licensing-autonomous-cars/ (suggesting the possibility of manufacturer liability for autonomous vehicle malfunctions).

120. *Id.* (suggesting also the possibility of automator liability autonomous vehicle malfunctions).

121. Marchant & Lindor, *supra* note 113, at 1328 (listing the manufacturer and programmer as potential parties to lawsuits arising out of autonomous vehicle accidents).

122. *See id.* at 1327 ("[I]f the driver failed to utilize, or was negligent in utilizing an available over-ride mechanism to assume control of the vehicle, he or she may be allocated

that the most likely theory to be applied is products liability, holding the automator responsible.[123] The article reasons that the automator is "responsible for the final product"—the autonomous vehicle—and that "when an autonomous vehicle does crash, most likely something went wrong with the collision avoidance system or the vehicle encountered conditions that it was not adequately programmed to address."[124] The transfer of liability from driver to automator may cause automators to "be reluctant to introduce technology" and will potentially lead to product-release delays.[125]

B. Criminal Liability

In addition to civil liability, autonomous vehicles raise questions about aspects of criminal liability. Presumably, every autonomous vehicle will be programmed to follow the rules of the road and will not violate traffic laws.[126] But assuming that the vehicle does violate a traffic law, the question arises whether the operator or the vehicle—and thus automator or programmer—is liable for the violation.[127] For strict liability offenses, such as speeding or failing to use a turn signal,[128] Nevada law seems to hold the operator, and not

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some or all of the blame for a resulting accident." (footnote omitted)); *see also* KALRA, ANDERSON & WACHS, *supra* note 43, at 19 ("[Strict] liability may be particularly relevant to liability of drivers of early autonomous vehicles. Victims . . . [may] argue that the operation of autonomous vehicle technologies constituted an ultrahazardous activity . . . ."); Robert W. Peterson, *New Technology—Old Law: Autonomous Vehicles and California's Insurance Framework*, 52 SANTA CLARA L. REV. 1341, 1355 (2012) ("One possible approach would be to invoke the various doctrines of products liability law.").

123. Marchant & Lindor, *supra* note 113, at 1328–29 ("In most cases, it will be the [automator] who will . . . be the party held liable for a crash involving an autonomous vehicle.").

124. *Id.* at 1327–29. The programmer, however, is not likely to be liable under products liability because "[c]omputer programming is a service rather than a product, and thus the actions of a computer programmer will be evaluated under a negligence or malpractice standard rather than under products liability." *Id.* at 1329 n.31.

125. KALRA, ANDERSON & WACHS, *supra* note 43, at 22.

126. *See* FLA. STAT. ANN. § 319.145(1)(d) (West Supp. 2013) (requiring that autonomous vehicles "[b]e capable of being operated in compliance with the applicable traffic and motor vehicle laws of this state"); NEV. ADMIN. CODE § 482A.190(2)(f) (2012) (the vehicle must be "capable of being operated in compliance with the applicable traffic laws of this State").

127. *See* Douma & Palodichuk, *supra* note 110, at 1160 ("If a car were truly in passenger mode any [traffic] violation would be a malfunction on the part of the vehicle.").

128. *Id.* at 1159; *Traffic Tickets and Violations in Nevada*, DMV (Apr. 28, 2011), http://www.dmv.com/nv/nevada/traffic-tickets.

the automator, liable.[129] However, when it comes to intent-based offenses, which require a prosecutor to establish *mens rea*, the answer may not be as simple.[130]

Autonomous technology in vehicles also introduces the risk that the technology will be susceptible to third-party attacks.[131] Already, researchers have found ways to hack critical safety components, demonstrating that autonomous technology may put drivers' and passengers' safety and privacy at risk.[132] These technologies rely on "a multitude of wireless communications applications, such as GPS, telematics, cellular, land-mobile, and Bluetooth,"[133] which each add a new potential breach point for malicious computer code.[134] When fully autonomous vehicles are introduced, they will further rely on these applications, in addition to commercial wireless services, vehicle radar, Dedicated Short-range Communications (DSRC), Wi-Fi, or a combination of the above approaches.[135] Professor Glancy at Santa Clara University School of Law predicts two different types of autonomous vehicles will emerge: "selfcontained" vehicles, which rely only on onboard information, and "interconnected" vehicles, which communicate wirelessly through a network.[136] She asserts that both types of vehicles, despite their differences, will present opportunities for data misuse.[137] Breaching an autonomous vehicle's entry points may do more than just release data; a hacker could potentially take

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129. *See* NEV. ADMIN. CODE § 482A.030(2) (2012) ("For the purpose of enforcing the traffic laws . . . the operator of an autonomous vehicle that is operated in autonomous mode shall be deemed the driver of the autonomous vehicle . . . .").

130. *See* Douma & Palodichuk, *supra* note 110, at 1159–60 (suggesting that with regard to intent-based offenses, "as long as the operator was merely acting as a passenger, negligence could not be found in the traditional sense").

131. *See* Cyrus Pinto, *How Autonomous Vehicle Policy in California and Nevada Address Technological and Non-Technological Liabilities*, 5 INTERSECT: STAN. J. SCI., TECH. & SOC'Y, No. 1, 2012, at 1, 5 ("There will also be unpredictable technological risks, such as the potential malicious attack by terrorists.").

132. *See* MCAFEE, CAUTION: MALWARE AHEAD 6–7 (2011), *available at* http://mcafee.com/autoreport ("Last year, researchers . . . demonstrated that critical safety components of a vehicle can be hacked . . . .").

133. Robert B. Kelly & Mark D. Johnson, *Defining a Stable, Protected and Secure Spectrum Environment for Autonomous Vehicles*, 52 SANTA CLARA L. REV. 1271, 1278 (2012).

134. *See* Dorothy J. Glancy, *Privacy in Autonomous Vehicles*, 52 SANTA CLARA L. REV. 1171, 1180 (2012) ("The vehicular communications network . . . would have many more potential data breach points at which personal information could be extracted, hacked or might leak out."); MCAFEE, *supra* note 132, at 6–7 (discussing current security vulnerabilities in already-existing driver-assisted technologies).

135. Kelly & Johnson, *supra* note 133, at 1279–84.

136. Glancy, *supra* note 134, at 1176–78.

137. *See id.* at 1178–80 (positing that while selfcontained vehicles may be more private than interconnected vehicles, both are vulnerable to hacking).

control of the vehicle and cause it to drive to a certain location.[138] However, since autonomous vehicles are not yet on the market, the criminal law system has not developed rules addressing these risks.[139] This Comment urges legislatures to codify crimes related to virtual carjacking of autonomous vehicles and to require autonomous vehicle manufacturers to implement data securitization measures in a response to some of the unanswered criminal liability questions surrounding autonomous vehicles.

IV. REGULATING AUTONOMOUS VEHICLES AND MINIMIZING LIABILITY

To resolve unanswered questions of both civil and criminal liability, legislators should "creat[e] a new set of regulations that will satisfy the public need for safety while simultaneously realizing the potential benefits of autonomous vehicle technology."[140] This Part will discuss possible solutions to the issues facing legislators, including: providing legal immunity for automators, analogizing to similar already existing technology, addressing data vulnerability through securitization and new criminal law statutes, changing current regulations for disengage systems, redefining an "operator" of an autonomous vehicle, and considering uniform federal preemption laws.

A. Legal Immunity

Automators may be hesitant to place autonomous vehicles on the market when they face high risks of liability.[141] When air bags were first introduced in the 1960s, vehicle manufacturers showed signs of resistance to incorporating them into their cars in fear that they would face more liability in the event of an air bag's failure.[142] Presently, however, air bags are installed in almost every vehicle due to changing public attitudes on vehicle safety and air bag expectations as well as improved technology and testing of air

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138. Douma & Palodichuk, *supra* note 110, at 1165 ("[T]he mere act of hacking into the control system of someone else's car can be analogized to stealing a car, and ultimately carjacking, should the car then take off with an unsuspecting passenger.").

139. *See id.* at 1164, 1169 ("One of the most severe criminal issue[s] to be dealt with goes back to the concept of being accountable for operating a car—a third party hacking into the computer system running the car and thereby controlling it.").

140. *See* Douma & Palodichuk, *supra* note 110, at 1162.

141. *See* KALRA, ANDERSON & WACHS, *supra* note 43, at 30 ("A manufacturer facing a decision as to whether to employ [autonomous] technology in its vehicles might very well decide not to, purely on the basis of expected liability costs.").

142. Jameson M. Wetmore, *Redefining Risks and Redistributing Responsibilities: Building Networks to Increase Automobile Safety*, 29 SCI., TECH., & HUMAN VALUES 377, 390–91 (2004).

bags.[143] Autonomous vehicles may follow the same path as air bags by facing initial resistance, but manufacturers are likely to overcome the resistance as the technology becomes more advanced and consumers become more familiar with its capabilities.[144]

One incentive to encourage automators to manufacture autonomous vehicles for the consumer market may be to provide them with a form of legal immunity from personal injury lawsuits, much like the immunity provided for producers of vaccines.[145] Vaccinations offer huge health benefits to society, but are not always harmless.[146] Regardless of the potential harmful effects, vaccine manufacturers are exempt from civil liability under the National Childhood Vaccination Injury Act of 1986 (NCVI) for vaccine-related injuries or deaths that "resulted from side effects that were unavoidable even though the vaccine was properly prepared and was accompanied by proper directions and warnings."[147] Providing qualified immunity for vaccine manufacturers does not leave injured plaintiffs entirely without a remedy; they may bring their claims in a forum Congress created under the same Act—the Vaccine Court.[148] Autonomous vehicles have the potential to bring equally large benefits to society, including increased safety, efficiency, and mobility.[149] To fully maximize these benefits and encourage automators to bring autonomous vehicles to consumers, this Comment urges legislatures to consider enacting legislation analogous to NCVI, which would shield automators from most civil liability.[150]

143. *Id.* at 390–92.

144. *See* KALRA, ANDERSON & WACHS, *supra* note 43, at 41–43 (providing suggestions for regulating autonomous vehicles to avoid manufacturer resistance).

145. *See* Marchant & Lindor, *supra* note 113, at 1331, 1335–36 (suggesting that immunity for manufacturers may remove a "serious" production and development barrier and noting that "[t]he public health benefit of vaccines is undeniable, yet they are so frequently the source of lawsuits that federal preemption laws had to be passed to protect their manufacturers.").

146. *Vaccines—Finding the Balance Between Public Safety and Personal Choice: Hearing Before the H. Comm. on Gov't Reform*, 106th Cong. 22 (1999) (statement of David Satcher, M.D., Surgeon General of the United States); *see also* Eva B. Stensvad, Note, *Immunity for Vaccine Manufacturers: The Vaccine Act and Preemption of Design Defect Claims*, 95 MINN. L. REV. 315, 318 (2010) ("Despite the many benefits vaccines confer upon society, they also occasionally injure those whom they are supposed to protect.").

147. 42 U.S.C. § 300aa-22(b)(1) (2006).

148. *See* Stensvad, *supra* note 146, at 323 ("[The Act] also established a Vaccine Court to hear these claims, in which injured parties are not required to prove causation or negligence . . . ." (footnote omitted)); *see also* 42 U.S.C. § 300aa-12 (laying out the jurisdiction of the Vaccine Court).

149. See *supra* notes 98, 102–06 and accompanying text for a discussion of the benefits.

150. *See* 42 U.S.C. §§ 300aa-11, 300aa-22 (establishing a framework that shields vaccine manufacturers from civil liability in some circumstances).

B. Analogies to Already Existing Autopilot Technology

Legislatures and courts may look to cases involving the use of autopilot in airplanes as an analogy for anticipated litigation arising out of autonomous vehicular accidents.[151] Many commercial planes fly using automated systems, such as autopilot, and these systems may serve as guidance for legislatures implementing regulations on autonomous technologies.[152] Because autonomous vehicles are not yet on the market, there have been no lawsuits involving their potential flaws.[153] Autopilot technologies have the potential to serve as a decent analogy for courts to interpret laws and liabilities because of the similarities in allowing for technological control instead of human control.[154]

On the other hand, the majority of cases involving autopilot technologies are based on pilot error, not technology failure.[155] Further, autopilot technologies rely heavily on a pilot being present to oversee the technology's operations, and the technology itself does not make adaptive changes.[156] These features would not be present in an autonomous vehicle because they would be contrary to the eventual goal of letting a self-

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151. *See* Marchant & Lindor, *supra* note 113, at 1324–25 ("[A]irplanes capable of flying on 'autopilot' (while also manned by a live pilot) provide a close analogy to autonomous vehicles."); *see also, e.g.*, Richardson v. Bombardier, Inc., No. 8:03CV544T31MSS, 2005 WL 3087864, at *14 (M.D. Fla. Nov. 16, 2005), *aff'd sub nom.* Ferguson v. Bombardier Servs. Corp., 244 F. App'x 944 (11th Cir. 2007) (holding that human error was the cause of an airplane crash, even though autopilot was engaged).

152. *See* Hayes, *supra* note 102, at 365–66 ("The layers of regulation would surely get thicker with computer-driven cars. . . . Road transport might become more like the airline system."); *see also* Marchant & Lindor, *supra* note 113, at 1324–25 (suggesting that analogous cases, such as autopilot airplanes, could be used as guidance in applying the product liability doctrine to autonomous vehicles).

153. *See* Marchant & Lindor, *supra* note 113, at 1324 ("[T]here has not been any reported personal injury litigation regarding [autonomous vehicles] to date.").

154. *See* Kyle Graham, *Of Frightened Horses and Autonomous Vehicles: Tort Law and Its Assimilation of Innovations*, 52 SANTA CLARA L. REV. 1241, 1252 (2012) ("[I]n resolving disputes that involve a new device, courts often focus on similarities in form between the innovation and existing technologies."); Marchant & Lindor, *supra* note 113, at 1325 (suggesting that airplanes equipped with autopilot "provide a close analogy to autonomous vehicles").

155. K. Krasnow Waterman & Matthew T. Henshon, *Imagine the Ram-if-ications: Assessing Liability for Robotics-Based Car Accidents*, SCITECH LAW., Spring 2009, at 14, 14 ("Although there are a handful of reported cases where autopilots played a role in the accident, in most cases the autopilot plays a lesser role than human oversight."); Dylan LeValley, Comment, *Autonomous Vehicle Liability—Application of Common Carrier Liability*, 36 SEATTLE U. L. REV. SUPRA 5, 9 (2013), *available at* http://seattleuniversitylawreview.com/files/2013/02/SUpraLeValley2.pdf.

156. *See* LeValley *supra* note 155, at 9–10; *see also* Waterman & Henshon, *supra* note 155, at 14.

driving vehicle *actually drive itself*, without even having a person in the car.[157] Finally, airplanes are not entirely comparable to cars, and autonomous technology on the ground will face different challenges than in the air, such as traffic, construction, congestion, and other drivers.[158] Courts, therefore, must use caution in applying autopilot cases as an analogy to autonomous car lawsuits.

C. Data Securitization and Criminal Codification

In order to avoid illegal transfers of data or virtual carjacking, legislators should enact regulations that require autonomous technology systems to frequently destruct and anonymize data; aggregate data within the vehicle; or "use vehicle authentication, encryption, tamper-proof hardware, real-time constraints, [or] user-defined privacy policies."[159] Some autonomous vehicles will naturally store and process vehicle location data and frequently traveled routes, making them "a repository of personal information about everywhere [the vehicle has] traveled."[160] Implementing data security measures would be indispensable in ensuring the driver's safety and protecting the driver's privacy.[161]

In addition to these regulations, the criminal legal system should codify laws prohibiting virtual carjacking and essentially equating the crime with today's prohibitions against manual carjacking.[162] Codifying these laws might deter future potential

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157. *See* Alessandro Saffiotti, *Fuzzy Logic in Autonomous Navigation*, *in* FUZZY LOGIC TECHNIQUES FOR AUTONOMOUS VEHICLE NAVIGATION 3, 3 (Dimiter Driankov & Alessandro Saffiotti eds., 2001) ("The goal of autonomous mobile robotics is to build physical systems that can move purposefully and without human intervention in . . . real-world environments . . . ."); LeValley, *supra* note 155, at 10.

158. *See* Hayes, *supra* note 102, at 366 ("[N]avigation and traffic management are easier in the wide-open spaces of the sky than on crowded, quasi-one-dimensional roadways.").

159. Glancy, *supra* note 134, at 1180; KPMG & CTR. FOR AUTOMOTIVE RESEARCH, *supra* note 2, at 27.

160. Glancy, *supra* note 134, at 1179–80.

161. *See id.* at 1180 (emphasizing the privacy risks associated with autonomous vehicles and noting that "personal information contained within the [autonomous] vehicle would be vulnerable to hacking [and] burglary"); Erik Derr, *Drive Toward Autonomous Cars Shouldn't Be So Automatic, Critics Warn*, WARDSAUTO (Oct. 8, 2012), http://www.wardsauto.com/politics/drive-toward-autonomous-cars-shouldn-t-be-so-automatic-critics-warn ("[H]aving your car hacked could translate to dire risks to your personal safety." (internal quotation marks omitted)).

162. *See* 18 U.S.C. § 2119 (2006) ("Whoever, with the intent to cause death or serious bodily harm takes a motor vehicle . . . from the person or presence of another by force and violence or by intimidation, or attempts to do so, shall . . . be fined under this title or imprisoned not more than 15 years, or both . . . ." (footnote omitted)); Douma &

violators from attempting to virtually take over an autonomous vehicle and may lay out severe punishments for violations, both of which are consistent with the goals of the criminal justice system.[163] This Comment urges legislatures to examine these laws *before* autonomous vehicles become prevalent in society to further enhance the deterrence effect and to prevent the first virtual carjackings from going unpunished.

D. Disengaging Autonomous Mode

In a further attempt to avoid carjacking and misuse of autonomous vehicles, regulations should go beyond requiring a disengage system within the vehicle and require one outside as well.[164] Nevada and California each have regulations requiring that the operator be able to take control of the vehicle, and thus disengage the autonomous software, "through the use of the brake, the accelerator pedal, or the steering wheel."[165] Florida requires only that the disengage system be "easily accessible to the operator."[166] Therefore, the currently implemented regulations in these three states do not require a means to disengage the autonomous software that is located outside the vehicle.[167]

It would not be difficult to require such a device, as there are already telematics systems, like General Motors' OnStar, that have the capability to remotely shut down a vehicle's engine on demand.[168] In the event that an unauthorized person hacks into an autonomous vehicle's technology and directs the vehicle to a different location when the operator is not in the vehicle, the

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Palodichuk, *supra* note 110, at 1159, 1164–65 (analogizing the hacking of an autonomous vehicle to the theft of a nonautonomous vehicle and noting that the "deployment of autonomous vehicles will . . . raise a number of potential 'new' crimes . . . that need to be addressed").

163. *See* Douma & Palodichuk, *supra* note 110, at 1158–59, 1169 (suggesting that certain traffic violations and vehicular crimes will need to be significantly changed to "achiev[e] the criminal law purposes of deterring and punishing misbehavior" and that "all states will need to contemplate . . . how to handle nefarious third party hackers").

164. California, Florida, and Nevada each require a disengage system that is easily accessible to the operator. CAL. VEH. CODE § 38750(c)(1)(A) (West Supp. 2013); FLA. STAT. ANN. § 319.145(1)(a) (West Supp. 2013); NEV. ADMIN. CODE § 482A.190(2)(b) (2012).

165. CAL. VEH. CODE § 38750(c)(1)(D); NEV. ADMIN. CODE § 482A.190(2)(g).

166. FLA. STAT. ANN. § 319.145(1)(a).

167. *See* CAL. VEH. CODE § 38750(c)(1)(D) (requiring only interior disengage systems); *see also* FLA. STAT. ANN. § 319.145(1)(a) (mandating only a disengage system that is "easily accessible"); NEV. ADMIN. CODE § 482A.190(2)(g) (mentioning only interior disengage systems).

168. Karen Mercedes Goertzel, *Software Survivability: Where Safety and Security Converge*, CROSSTALK, Sept.–Oct. 2009, at 15, 16. Other vehicle systems include Volvo's On Call, BMW's Assist, and Mercedes-Benz's Tele Aid and COMAND. *Id.*

operator would have a way to override the subsequent directions or disengage the autonomous system, causing the vehicle to pull over and park itself in a safe location[169] To be effective, the exterior disengage function must be secured against third-party attacks; otherwise, a skilled hacker could disable the function, leaving the operator back where she started.[170] Therefore, regulations should require a secured disengage device both inside and outside of the autonomous vehicle to prevent technological malfunctions and third-party takeovers.

E. Clarifying the "Operator"

One article suggests that a distinction should be made between "operating" a vehicle (by keying in directions and then reading a book, for example) and "operating a vehicle in a meaningful way" (by taking control of the vehicle or disengaging the autonomous technology) in order to solve problems of civil and criminal liability.[171] The article proposes that liability would fall on the automators when a person is simply operating the vehicle but not operating it in a meaningful way.[172] Because the vehicle would be driving in fully autonomous mode when the person is not operating in a meaningful way, there would be a collision only when the vehicle malfunctioned because of the automator's mistake or negligence.[173] On the other hand, a person who *is* operating in a meaningful way may be subject to liability for any car accident

169. *See* CAL. VEH. CODE § 38750(c)(1)(C)(ii) ("If the operator does not or is unable to take control of the autonomous vehicle, the autonomous vehicle shall be capable of coming to a complete stop."); NEV. ADMIN. CODE § 482A.190(2)(d)(2) ("If the operator is unable to take control of or is not physically present in the autonomous vehicle, [the vehicle must be] equipped with technology to cause the autonomous vehicle to safely move out of traffic and come to a stop."); *see also Vehicle Disabling Systems*, FED. MOTOR CARRIER SAFETY ADMIN., http://www.fmcsa.dot.gov/facts-research/systems-technology/product-guides/vehicle-disabling.htm (last visited Sept. 21, 2013) (discussing remote vehicle disabling systems). The engine shut-off function provided by OnStar is often used in the case of stolen vehicles. Goertzel, *supra* note 168, at 16.

170. *See* Karl Koscher et al., *Experimental Security Analysis of a Modern Automobile*, *in* PROCEEDINGS OF THE 2010 IEEE SYMPOSIUM ON SECURITY AND PRIVACY 477, 457–58 (2010), *available at* http://www.computer.org/csdl/proceedings/sp/2010/4035/00/4035a447-abs.html (showing that scientists could effectively manipulate, engage, and disengage a vehicle's systems remotely); *see also* MCAFEE, *supra* note 132, at 6 ("[W]eb-based vehicle-immobilization systems that can remotely disable a car could be manipulated [by hackers] . . . .").

171. Douma & Palodichuk, *supra* note 110, at 1160.

172. *Id.* at 1161.

173. *See id.* at 1160 ("[A]s long as the operator was merely acting as a passenger, negligence could not be found in the traditional sense.").

that occurs because the vehicle would essentially be a nonautonomous vehicle.[174]

Black boxes may provide valuable information about whether the car was being operated in a meaningful way before a specific violation or accident occurred and could help establish civil or criminal liability.[175] These black boxes, which two of the three states that have enacted legislation currently require, can record the vehicle's sensor data for thirty seconds prior to an accident and must store the recording on file for three years.[176] Therefore, the black boxes serve as a digital transcript of the accident, providing data on variables such as vehicle speed, brake status, throttle position, engine speed, and even whether the driver was wearing a seatbelt.[177] Newer versions of black boxes would presumably record whether the vehicle was in autonomous mode at the time of the accident.[178]

Distinguishing between operating a vehicle and operating a vehicle in a meaningful way may still leave some gray areas where establishing liability is not as easy. For example, an automator may provide a warning that a certain vehicle cannot be driven in autonomous mode on icy roads.[179] A driver who ignored this warning and engaged the autonomous mode would *not* be operating the vehicle in a meaningful way, as defined above,[180] because she would not be in control of the vehicle, but

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174. *See id.* at 1161–62 (discussing the needs of prosecutors in bringing charges against persons operating autonomous vehicles in a meaningful way).

175. *See id.* at 1162 (suggesting the use of a "time stamp" to assist in criminal prosecutions); *see also* Jaclyn Trop, *A Black Box for Car Crashes*, N.Y. TIMES, July 21, 2013, at B1 (noting that an event data recorder is more commonly known as a black box).

176. CAL. VEH. CODE § 38750(c)(1)(G) (West Supp. 2013); NEV. ADMIN. CODE § 482A.110(2)(b) (2012).

177. *See* AUGUSTUS CHIDESTER ET AL., NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., RECORDING AUTOMOTIVE CRASH EVENT DATA (May 5, 1999), *available at* http://www.nhtsa.gov/DOT/NHTSA/NRD/Articles/EDR/PDF/Research/Recording_Automotive_Crash_Event_Data--Presentation_No-5.pdf (providing a list of variables that GM's airbag system can store); Press Release, Nat'l Highway Transp. Admin., U.S. DOT Proposes Broader Use of Event Data Recorders to Help Improve Vehicle Safety (Dec. 7, 2012), http://www.nhtsa.gov/About+NHTSA/Press+Releases/U.S.+DOT+Proposes+Broader+Use+of+Event+Data+Recorders+to+Help+Improve+Vehicle+Safety (listing the types of information that EDRs record).

178. *See* Douma & Palodichuk, *supra* note 110, at 1168 ("Given the amount of data autonomous vehicles will need to process, it is certain that at least some, if not all, of that data will be recorded as well . . . ."); *infra* note 184.

179. *See* Marchant & Lindor, *supra* note 113, at 1323–24 ("The manufacturer of an autonomous vehicle may . . . have a duty to disclose known risks of failure, including any known or suspected failure modes.").

180. *See supra* notes 171–74 and accompanying text.

she may still be held liable for negligently engaging the system.[181] In this case, the general rule that an automator is liable when the driver is not operating the vehicle in a meaningful way would not apply because the driver assumes the risk of an accident by operating the vehicle negligently.[182] However, the main distinction between operating an autonomous vehicle and operating a vehicle in a meaningful way would cover many instances of liability,[183] and legislatures should require black boxes in vehicles that can collect data regarding what mode of operation the vehicle was in at the time of an accident.[184]

This Comment also suggests that if autonomous vehicle regulations are to be effective, they must be uniform. The first step toward uniform regulation is to establish a singular definition of an autonomous vehicle "operator."[185] Currently, Nevada and Florida similarly define an "operator" as a person who engages the autonomous technology of a vehicle, regardless of whether the person is physically present in the vehicle while it is engaged.[186] California, however, defines an "operator" as "the person who is seated in the driver's seat, or if there is no person in the driver's seat, causes the autonomous technology to engage."[187] Imagine a situation where a mother places her eight-

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181. *See* Marchant & Lindor, *supra* note 113, at 1326–27 ("When the driver has a choice to turn on the autonomous system and exercised [sic] that choice negligently, the apportionment of responsibility between the car and driver may be more difficult.").

182. *See* Douma & Palodichuk, *supra* note 110, at 1160 ("[A]s long as the operator was merely acting as passenger, negligence could not be found in the traditional sense."); Marchant & Lindor, *supra* note 113, at 1326–27.

183. Douma & Palodichuk, *supra* note 110, at 1160–61.

184. *See* NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY STATEMENT OF POLICY CONCERNING AUTOMATED VEHICLES 14 (May 30, 2013), *available at* www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf ("[T]he recording should note whether the automated technology system was in control of the vehicle at the time of the crash.").

185. *See* Douma & Palodichuk, *supra* note 110, at 1162 ("The first problem state legislatures will face is the use of the word 'operate,' which will either need to be redefined or at the very least, distinguished."). *See generally* Bryant Walker Smith, *My Other Car Is a . . . Robot? Defining Vehicle Automation*, CTR. FOR INTERNET & SOC'Y (Feb. 19, 2012, 7:45 PM), http://cyberlaw.stanford.edu/blog/2012/02/my-other-car-robot-defining-vehicle-automation (focusing on the efforts of researchers and regulators to "systematically define, divide, and denote this growing spectrum of automotive automation" in the context of vehicular technology).

186. NEV. ADMIN. CODE § 482A.020 (2012) ("[An operator is] the person [who] causes the autonomous vehicle to engage, regardless of whether the person is physically present in the vehicle while it is engaged."); *see also* FLA. STAT. ANN. § 316.85(2) (West Supp. 2013) ("[An operator is] the person [who] causes the vehicle's autonomous technology to engage, regardless of whether the person is physically present in the vehicle while the vehicle is operating in autonomous mode.").

187. CAL. VEH. CODE § 38750(a)(4) (West Supp. 2013).

year-old child in the driver's seat of her autonomous vehicle in Nevada and sends him to visit his grandparents in California. When she does so, she is the legal operator in Nevada, but her child becomes the legal operator as soon as the car crosses into California.[188] Assuming that the vehicle wrecks in California, there may be some difficult liability issues to resolve because an eight-year-old cannot legally operate an autonomous vehicle in the first place.[189]

It is clear, then, that California's definition fails to recognize some of the benefits of autonomous vehicles in first defining the operator as "the person . . . in the driver's seat," and only in the alternative assigning the person who engaged the software to be the operator.[190] A benefit of self-driving vehicles is the increased mobility they provide for otherwise unable drivers.[191] As previously mentioned, a parent could send her young child to school in an autonomous vehicle and, under Nevada and Florida's definitions, the parent would remain liable as the operator of the vehicle if the vehicle crashed.[192] Further, under Nevada and Florida law, a person could program an autonomous vehicle to take his drunk friend home without transferring the liability to the drunk friend, because the friend—acting as the engager—would be the operator.[193] Under California's definition, however, the child and the drunken friend become operators if they are seated in the driver's seat of the vehicle.[194] Because of the flaws in the California definition described above, this Comment urges California and other states to adopt Florida and Nevada's definitions when considering their own autonomous vehicle regulations.

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188. *See id.* (defining an operator as the person in the driver's seat); NEV. ADMIN. CODE § 482A.020 (defining an operator as the person who engages the autonomous mode).

189. *See* CAL. VEH. CODE § 38750(b) ("An autonomous vehicle may be operated . . . by a driver who possesses the proper class of license for the type of vehicle being operated."); CAL. VEH. CODE § 12512 (West 2010) ("[N]o license to drive shall be issued to a person under the age of 18 years.").

190. CAL. VEH. CODE § 38750(a)(4) (West Supp. 2013).

191. *See* Beiker, *supra* note 3, at 1151–52 (discussing the benefits to adolescents and the elderly).

192. *See* NEV. ADMIN. CODE § 482A.020; *see also* FLA. STAT. ANN. § 316.85(2) (West Supp. 2013) ("[An operator is] the person [who] causes the vehicle's autonomous technology to engage, regardless of whether the person is physically present in the vehicle while the vehicle is operating in autonomous mode.").

193. FLA. STAT. ANN. § 316.85(2); NEV. ADMIN. CODE § 482A.020.

194. *See* CAL. VEH. CODE § 38750(a)(4) (defining an operator as the person in the driver's seat).

F. Federal Preemption

A final alternative to solving problems arising out of different definitions of an "operator" is for the federal government to preempt state laws by creating its own regulations of autonomous vehicles.[195] Congress has the power to regulate vehicles, as instrumentalities of interstate commerce, under the Commerce Clause of the Constitution.[196] Additionally, Congress has used its general welfare and national security powers to create the Department of Transportation, whose goals include "encourag[ing] cooperation of Federal, State, and local governments" to improve transportation.[197] Additionally, Congress has the option to create exclusively federal laws and regulations by preempting state statutes under the Supremacy Clause of the Constitution, and it has done so in its regulation of automobiles.[198]

For example, in 1984, the Department of Transportation enacted Federal Motor Vehicle Safety Standard 208, which required vehicle manufacturers to incorporate passive restraint devices into some vehicles manufactured in 1987.[199] Standard 208 did not require a certain type of passive restraint device but gave the manufacturer a variety of options.[200] While driving a 1987 Honda, Alexis Geier was injured in a motor vehicle accident and sued Honda under District of Columbia tort law, alleging that Honda had a duty to install a driver's side air bag and

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195. *See* KALRA, ANDERSON & WACHS, *supra* note 43, at 32–34 (discussing federal preemption of state tort law).

196. *See* U.S. CONST. art. I, § 8, cl. 3 ("The Congress shall have Power . . . To regulate Commerce with foreign Nations, and among the several States, and with the Indian Tribes . . . ."); *see also* United States v. Morrison, 529 U.S. 598, 609 (2000) ("Second, Congress is empowered to regulate and protect the instrumentalities of interstate commerce . . . ." (quoting United States v. Lopez, 514 U.S. 549, 558 (1995) (internal quotation marks omitted))); United States v. Bishop, 66 F.3d 569, 589 n.32 (3d Cir. 1995) ("[T]he power to regulate instrumentalities of interstate commerce is the power to regulate vehicles used in interstate commerce . . . .").

197. 49 U.S.C. § 101(b)(3) (2006); Department of Transportation Act, Pub. L. No. 89-670, § 3(a), 80 Stat. 931 (1966).

198. *See* U.S. CONST. art. VI, cl. 2 ("This Constitution, and the Laws of the United States . . . shall be the supreme Law of the Land . . . ."); *see also* Geier v. Am. Honda Motor Co., 529 U.S. 861, 884–86 (2000) ("[T]he statute foresees the application of ordinary principles of pre-emption in cases of actual conflict. Hence, the tort action [regarding automobile safety restraints] is pre-empted.").

199. Federal Motor Vehicle Safety Standard; Occupant Crash Protection, 49 Fed. Reg. 28,962, 28,962–63 (July 17, 1984) (to be codified at 49 C.F.R. pt. 571); *Geier*, 529 U.S. at 864–65.

200. Federal Motor Vehicle Safety Standard; Occupant Crash Protection, 49 Fed. Reg. at 29,009–10; *Geier*, 529 U.S. at 874–75.

was negligent in failing to do so.[201] The U.S. Supreme Court found that the lawsuit conflicted with Standard 208's objectives because the Standard did not impose a duty on Honda to install *air bags* specifically, and, therefore, the lawsuit was preempted by the Standard 208 and the National Traffic and Motor Vehicle Safety Act of 1966.[202]

In the context of autonomous vehicles, the Department of Transportation has yet to enact any regulations.[203] The Department has recommended some requirements for different driver-assistance technologies and has developed its own program investigating vehicle-to-vehicle communication and its potential benefits.[204] However, if it chose to do so, the Department could promulgate regulations that would protect manufacturers from some lawsuits and establish uniform requirements and definitions for autonomous vehicles.[205] This would both encourage the introduction of fully autonomous vehicles on the consumer market and ease some of the issues arising from conflicting state laws.[206] Even though these issues have not arisen yet, this Comment urges Congress and the Department of Transportation to institute uniform regulations for autonomous vehicles because potential liability may keep automators from producing the technology, and waiting for courts to determine these important liability issues may damper the societal benefits that these vehicles are designed to offer.[207]

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201. *Geier*, U.S. at 864–65, 881.

202. *Id.* at 865, 867, 874–75, 886.

203. KALRA, ANDERSON & WACHS, *supra* note 43, at 39; Marchant & Lindor, *supra* note 113, at 1339.

204. *See* KALRA, ANDERSON & WACHS, *supra* note 43, at 40 ("The US DOT has published a set of voluntary operational requirements for [collision warning systems] and [advanced cruise control], but it does not serve as a standard, specification, or regulation." (citation omitted)); *see also supra* notes 65–68 and accompanying text (discussing the DOT's program).

205. *See* Marchant & Lindor, *supra* note 113, at 1339 ("It is conceivable, however, that the agency may adopt such standards in the future if autonomous vehicles are likely to become prevalent and raise unique safety issues.").

206. *See* Marchant & Lindor, *supra* note 113, at 1335–39 (suggesting that legislative action could help minimize liability and thus ease the introduction of autonomous vehicles); Joseph B. White, *Self-Driving Cars Spark New Guidelines*, WALL ST. J. (May 30, 2013), http://online.wsj.com/article/SB10001424127887323728204578515081578077890.html#printMode ("[R]egulatory consistency and industry collaboration can help put [autonomous vehicle] technologies on the road quicker." (internal quotation marks omitted)).

207. Marchant & Lindor, *supra* note 113, at 1335–39.

V. CONCLUSION

The first consumer autonomous vehicle will likely appear on the market within the next fifteen years.[208] Already, autonomous vehicles are being tested in California, Nevada, and Florida, as well as in places across the world, and are capable of driving without any human intervention.[209] Consumers already drive vehicles equipped with driver-assistance technologies that maintain a set speed and distance, accelerate and brake, alert the driver when she changes lanes, park themselves, and communicate with other vehicles.[210] These technologies and fully autonomous cars both have the capability to increase safety, efficiency, and mobility, which may make them very attractive to consumers.[211]

Although three states have enacted legislation regarding autonomous vehicles,[212] there remain many more questions regarding the civil and criminal liability that will arise from autonomous vehicle crashes or statutory violations.[213] While most lawsuits involving vehicular accidents today involve negligence allegations against the driver, autonomous vehicles technically do not have a human driver.[214] Instead, autonomous vehicle manufacturers may face product liability lawsuits alleging a manufacturing defect, design defect, or a failure to warn of limitations or uses of the autonomous vehicle.[215] This shift in liability has the potential to produce a delay in the introduction of fully autonomous vehicles, which would stall the enormous benefits autonomous vehicles can provide.[216]

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208. *See* Vaughan, *supra* note 88 ("Continental revealed a plan that pulls Fully Automated Driving on high-speed highways in 2025. Partially Automated Driving comes first in 2016 and Highly Automated driving could happen by 2020."); *see also* Paul A. Eisenstein, *Driver Becomes 'Co-Pilot' in the Self-Drive Car*, NBC NEWS (Aug. 28, 2013, 11:17 AM), http://www.nbcnews.com/business/driver-becomes-co-pilot-self-drive-car-8C11022532.

209. Vanderbilt, *supra* note 87, at 86; *California Moves Into the Self-Driving Lane*, *supra* note 78; *see also* Bertozzi et al., *supra* note 95, at 122–24 (describing an autonomous journey from Parma, Italy, to Shanghai, China).

210. *See supra* Part II.A (describing these technologies).

211. Beiker, *supra* note 3, at 1149; Ford, *supra* note 98, at 42.

212. CAL. VEH. CODE § 38750 (West Supp. 2013); FLA. STAT. ANN. §§ 316.85–316.86, 319.145 (West Supp. 2013); NEV. ADMIN. CODE § 482A (2012).

213. *See* Marchant & Lindor, *supra* note 113, at 1326 ("Autonomous vehicles are likely to change the dynamics of who may be held [civilly] liable."); *see also* Douma & Palodichuk, *supra* note 110, at 1162–68 (discussing criminal liability implications from autonomous vehicles).

214. *See* KALRA, ANDERSON & WACHS, *supra* note 43, at 17–21; Marchant & Lindor, *supra* note 113, at 1323, 1326.

215. *See* Marchant & Lindor, *supra* note 113, at 1323–24, 1328–29 ("In most cases, it will be the vehicle manufacturer who will . . . be the party held liable for a crash involving an autonomous vehicle.").

216. KALRA, ANDERSON & WACHS, *supra* note 43, at 22.

Besides civil liability, there are criminal liability issues surrounding autonomous vehicles as well.[217] Autonomous vehicles may violate criminal statutes and will create an opportunity for virtual carjacking.[218] Finally, the technological nature of autonomous vehicles will make driver and passenger data vulnerable to third-party attacks and misuse.[219]

To address these issues, legislatures must work on developing regulations that predict and attempt to resolve gray areas of liability.[220] Congress and the Department of Transportation may choose to enact federal regulations that will preempt state laws and create a uniform set of standards for autonomous vehicles.[221] Federal regulations would solve many issues arising out of conflicting state laws, such as the current variation in the term "operator,"[222] and may provide automators with some form of legal immunity.[223] In the alternative, states should enact legislation that addresses data vulnerability by requiring security systems to prevent against threats, and they must create new criminal law statutes addressing potential misuse of autonomous vehicles and their data.[224] These regulations and laws might also include requiring an exterior disengage function in all autonomous vehicles in order to prevent carjacking and data abuse.[225] Last, courts may find analogies to

217. *See supra* Part III.B (discussing criminal liability in an autonomous vehicle context).

218. *See* Douma & Palodichuk, *supra* note 110, at 1160 ("If a car were truly in passenger mode any [traffic] violation would be a malfunction on the part of the vehicle."); *see also id.* at 1164–66 ("[T]he mere act of hacking into the control system of someone else's car can be analogized to stealing a car, and ultimately carjacking . . . .").

219. *See* Glancy, *supra* note 134, at 1176–78 (discussing the data generated, transmitted, and stored by an autonomous vehicle); *see also* Pinto, *supra* note 131, at 5 ("There will also be unpredictable technological risks, such as the potential malicious attack by terrorists.").

220. Douma & Palodichuk, *supra* note 110, at 1162.

221. *See supra* Part IV.F (discussing federal regulations).

222. *Compare* FLA. STAT. ANN. § 316.85(2) (West Supp. 2013) ("[An operator is] the person [who] causes the vehicle's autonomous technology to engage, regardless of whether the person is physically present in the vehicle while the vehicle is operating in autonomous mode."), *and* NEV. ADMIN. CODE § 482A.020 (2012) ("[An operator is] the person [who] causes the autonomous vehicle to engage, regardless of whether the person is physically present in the vehicle while it is engaged."), *with* CAL. VEH. CODE § 38750(a)(4) (West Supp. 2013) ("[An operator is] the person who is seated in the driver's seat, or if there is no person in the driver's seat, causes the autonomous technology to engage.").

223. *See supra* Part IV.A (discussing automator immunity).

224. *See* Glancy, *supra* note 134, at 1180 ("[I]nterconnected autonomous vehicle[s] present[ ] more risks to personal information . . . . [and] legislation or regulation may require strong network privacy protections . . . ."); *see also* KPMG & CTR. FOR AUTOMOTIVE RESEARCH, *supra* note 2, at 21, 27 (observing automators' preferences with respect to a government mandate and discussing data-protection risk).

225. *See supra* Part IV.D (discussing a disengage function).

already existing similar technologies, like autopilot on airplanes, useful in evaluating lawsuits based on autonomous vehicle accidents.[226] Whichever method is utilized, working out the kinks now—before fully autonomous vehicles arrive on the consumer market—will maximize their benefits while creating a safe environment in which they can drive.[227]

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226. *See* Marchant & Lindor, *supra* note 113, at 1324–25 ("[A]irplanes capable of flying on 'autopilot' (while also manned by a live pilot) provide a close analogy to autonomous vehicles.").

227. Douma & Palodichuk, *supra* note 110, at 1162.