



# HOTSEAT

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Nissan has announced that it will offer a driverless car in 2021. There is no doubt others are working on similar technology. Contributing to the effort, the European Union is debating implementing speed limit signs that signal cars to brake if they detect an offender. Similar ideas are being discussed in the U.S.

**DRIVERLESS TECHNOLOGY, IN ITS FUNDAMENTAL FORM**, already exists in academia and private consortiums. The basic components are here: GPS can track and sense a car's position anywhere, along with its location, speed, direction, and altitude. OnStar can turn the car's engine off and control most computer-controlled functions. Sensors such as infrared and radar can detect the car's position on the highway and its distance from other cars. There's almost nothing left to the imagination—technology exists to control practically everything. However, the applicable artificial intelligence required to approach human decision making in real world traffic is still a ways off.

Driverless automobile technology is probably just one of the hundreds of R&D projects on the drawing boards and in development around the world and most, if not all, are targeting the "green revolution" as the justification. One in particular is called Controlled Rotation System [CRS], a bicycle transmission morphed to replace the gearbox in cars. CRS has been patented by Parts Services Holland, Ltd.—formed in 2009 by four people in Holland to replace the Deraileur bicycle chain-jumping sprockets by using a belt and only two discs whose diameters can be hydraulically changed to alter their ratio. Unlike the CVT, continuously variable transmission, where the belt rides up and down cones to vary the ratio, the CRS's belt is in constant contact with each disc as the diameters change. In theory, according to the inventors, the motor could run at a constant RPM and the car's speed and torque would be increased or decreased by just changing the disc's diameters. Obviously a clutch or torque converter of some design would still be required to accommodate engine/motor disengagement from the CRS.

Beyond tripping over this device via an internet search, I know nothing more about it other than the principles expect it to force a sea-change in how future automobiles will be designed. In addition, the company sees application for wind turbines among other power transmission devices. Their goal is to improve operating efficiency by eliminating gears thereby per their claims reduce friction losses.

There's a big "but": The auto industry has a long history with belts, and anyone with experience with belts know that they stretch—requiring a tensioning idler of some sort. Belts for direct drive applications were eventually dropped, and chains took their place.


However, chains eventually stretch as well. Remember Honda's early rubber timing belts that required changing at 150,000 miles to avoid valves smashing into the tops of pistons?

At this time, I don't believe any (drivetrain) belts currently in use, if in fact there are in use, are made from rubber compounds, steel-reinforced or not. One of the first below the radar successful chain-drive transmission applications was used in the 1966 Olds Toronado. Originally patented by Ford years earlier, it never saw the light of day. Ford conceived a chain directly driving the transmission input shaft from the engine output or crankshaft. For Olds, this novel FWD system allowed the "V" engine to be positioned longitudinally, as in RWD cars, with a special high strength; heat treated and pre-stretched chain connecting the side-saddle rear-pointing transmission to the engine crank shaft. This engine/transmission combination was used for many years and even drove GMC's 1973-'78 Motorhome.

Will the CRS survive in its current form when the belt is designed to accommodate the horsepower in today's automobile engines survive? That is the challenge, considering all of the past unsuccessful attempts to replace gears in an automobile transmission, driverless or not.

It's not easy to duplicate the load and direction-changing ability that hardened gears offer to thousands of applications (for which the automobile transmission and differential are the most advanced—they're used by more people around the world than any other system). And there's a good reason why: Transferring energy from the motor to the wheels creates large compressive and tensile stresses within the gear teeth, in addition to whisper-quiet precision. Chains and belts, on the other hand, can be surprisingly noisy, especially at high RPM.

With my limited knowledge of the material detail of the CRS device, I see three possible options: Heat-treated steel chain, composite reinforced linked chain, or a space-age rubber or polymer reinforced belt. Most likely hardened steel micro-linked chain, modified to ride on the toothless expanding discs, will be required. If gears were used, the continuously expanding and contracting disc diameter would cause the gear module to change, altering the pitch. In any case, the hydraulically expanded discs will see very high wear, thus require a heat-treated surface (a perfect application for nitriding, actually).

The RPM required for a bicycle is one thing—the wear and load-carrying ability required for a 200- to 400-horsepower automobile is quite another. Even with the comparatively low loads endured by racing bicycles for which I assume the CRS was developed, the current bicycle chain-drive systems are changed frequently. Note in the Tour de France the multitude of bicycles every team uses to compete over just a few days. 

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