

## **MODELING THE CONTINUOUS VARIABLE TRANSMISSION SYSTEM**

A continuously variable transmission, or CVT, is a type of automatic transmission that provides more useable power, better fuel economy and a smoother driving experience than a traditional automatic transmission.

Conventional automatic transmissions use a set of gears that provides a given number of ratios (or speeds). The transmission shifts gears to provide the most appropriate ratio for a given situation: Lowest gears for starting out, middle gears for acceleration and passing, and higher gears for fuel-efficient cruising.

The CVT replaces the gears with two variable-diameter pulleys, each shaped like a pair of opposing cones, with a metal belt or chain running between them. One pulley is connected to the engine (input shaft) and the other to the drive wheels (output shaft). The halves of each pulley are movable; as the pulley halves come closer together the belt is forced to ride higher on the pulley, effectively making the pulley's diameter larger.

Changing the diameter of the pulleys varies the transmission's ratio (the number of times the output shaft spins for each revolution of the engine), in the same way, that a 10-speed bike routes the chain over larger or smaller gears to change the ratio. Making the input pulley smaller and the output pulley larger gives a low ratio (a large number of engine revolutions producing a small number of output revolutions) for better low-speed acceleration. As the car accelerates, the pulleys vary their diameter to lower the engine speed as car speed rises.

This is the same thing a conventional transmission does, but instead of changing the ratio in stages by shifting gears, the CVT continuously varies the ratio -- hence its name.

To describe CVT systems, it is necessary to use a system of ordinary differential equations with a special right-hand side, which can be elements of nonlinearity in describing limitations on the functioning of a mechanical system.