Bench-scale Demonstration of Flywheel Energy Storage and Release via a Continuously Variable Transmission.

Alan Westbay
Mercer University

EXTENDED ABSTRACT

Continuously variable transmissions (CVTs) allow for an infinite set of gear ratios, between a set maximum and minimum, which can be adjusted without disconnecting either the driving power or the driven load. Theoretically, a CVT could be coupled with a high moment of inertia flywheel to efficiently store energy in rotational energy of the flywheel. If flywheel based energy storage proves to be efficient and practical in automobiles, it would provide an alternative means of regenerative braking than the battery or super capacitor systems currently being explored. This storage system should not have the high price, relatively short life cycle, and inefficient recharge process of batteries. It could also prove to lack the inherent inefficiencies in any electrically based regenerative braking system, and could be integrated into vehicles that do not use electric drive motors; currently the vast majority of automobiles on the market.

In this project, the concept of using a CVT to store rotational energy in a flywheel was explored. Two moveable sheave setups were acquired from the centrifugal clutch systems of available motor scooters. One of these was coupled with a 7 to 1 reduction gearbox with the output splined to a motor scooter's rear driven wheel. The tire of the rear wheel was filled with water, to increase its mass and moment of inertia. The two sheave setups were mounted on a wooden frame, and connected by a V-type drive belt. A lever system was implemented to change the radii of each sheave setup, inversely. Thus as the radii of one pulley was increased, the other would be allowed to decrease. One sheave of one of the setups was kept under tension via spring, in order to maintain the tension in the belt required to transmit power. The sheave setup not splined to a wheel can be driven by an electric motor, or other source of rotational energy which in turn drives the free spinning wheel, acting as a flywheel. The CVT actuating lever can be continually adjusted to constantly increase the angular velocity of the flywheel, while the motor is kept at a constant speed, until the maximum ratio limit is reached. The system can then be run in reverse, with the motor wired as a generator, to show how the rotational energy of the flywheel can be smoothly converted back to rotational energy of the motor's armature and then electrical power. In an automotive application, the vehicle's driveshaft could take the place of the electric motor. In this way, kinetic energy of the vehicle could be stored in rotational energy of the flywheel when braking is necessary. That rotational energy could then be converted back to kinetic energy when acceleration is again required, through entirely mechanical means.