

HOW FINITE ELEMENT ANALYSIS ASSISTED IN THE DEVELOPMENT OF A REVOLUTIONARY INFINITELY VARIABLE TRANSMISSION SYSTEM

For the last 15 years, Torotrak (Development) Limited, have been developing a revolutionary new transmission system for motor vehicles.

The impetus behind this work is the fundamental limitation of existing manual and automatic transmission systems. Ideally, the engine speed should always be matched to the road speed of a vehicle, but because of the finite number of gears that may be selected (typically 5 in manuals, 4 in automatics), in use, the driver is continually making a compromise between engine and road speeds. Therefore the engine is rarely able to operate at it's most efficient speed. This is undesirable because the engine will consume more fuel under these conditions, thereby generating more noxious exhaust gases.

Torotrak have overcome this problem by designing the Infinitely Variable Transmission system (IVT). As the name implies, this system is capable of generating an infinite number of forward and reverse gear ratios, thereby providing the ideal gear to ensure the engine is always operating at it's most efficient.

At the heart of the Torotrak IVT is a device called a variator (see Figure 1). Consisting of input (items A) and output discs (items B), the space between these discs forms a hollow doughnut (or "toroid"). Within each toroid sit three roller units (item C). Drive from the engine is fed to the variator via the input discs, and by changing the angle of contact between the rollers and discs, the speed of the output discs may be infinitely varied.

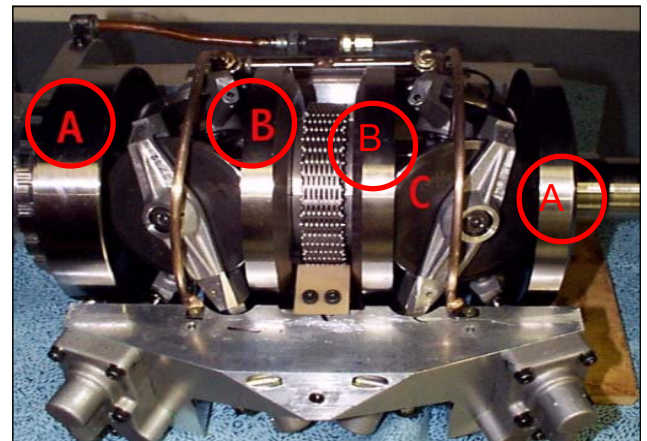


Figure 1

To assist in understanding the considerable forces created within the variator, Torotrak contracted FEA Online to create a finite element analysis model of the disc and roller assembly (Figure 2). A variety of worst case operational conditions were then defined and solved to provide deflection and stress levels within the variator component parts.

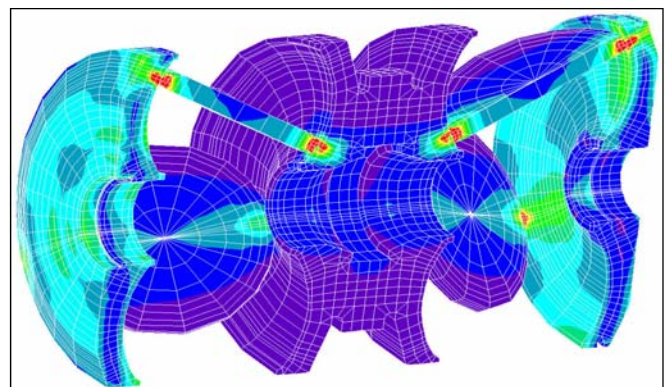


Figure 2

To date, IVT transmission systems have been undergoing rigorous field trials with several major car and commercial manufacturers, which have yielded fuel savings of at least 17% over equivalent vehicles with manual transmission. Further details on the Torotrak IVT can be obtained from www.torotrak.com.

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