

Fig 1: Spline coupling with angular misalignment

Spline Coupling

WHAT ARE SPLINE COUPLINGS?

Spline couplings are commonly used connection devices within drivetrains for transmitting torque. The device consists of a spur gear fitted within a ring gear which permits axial displacement between the components. High torsional stiffness is achieved with contact occurring at every tooth pair. Generally, the sleeve's ring gears have unmodified flanks, whereas the pinion's spur gears are rounded by means of crowning [Fig. 2]. This enables angular misalignment between the two coupling gear wheels. Small radial offsets can be allowed by applying backlash although, under load, the device is self-centering.

“Based on the SIMPACK Gear Pair force element, the spline coupling uses the same gear wheel primitives.”

Double spline coupling shafts are often incorporated as connections to the free floating suns of planetary stages, having a similar functionality to cardanic shafts. The allowable radial misalignment is proportional to the distance between the couplings. The spline coupling also permits the sun to tilt relative to the connecting shaft and therefore remain primarily parallel to the planetary gear wheels.

Particular advantages of spline couplings over other devices are:

- Equally distributed load along the circumference
- Small installation size
- Transfer of rotational concentricity
- Angular misalignments
- Can allow for radial misalignment
- Suitability for high rotation speeds
- Relatively insensitive to overloading

Because spline couplings are such an important component of many drivetrain applications, SIMPACK users need to have the ability to quickly and easily model these components and generate required measurements. This is now possible with the new spline coupling element in SIMPACK 9.

SPLINE ELEMENT IN SIMPACK

Based on the SIMPACK Gear Pair force element, the spline coupling uses the same gear wheel primitives (see article “SIMPACK

Gear Pair Enhancements”, SIMPACK News, September 2010, page 25–26:). If used, the shift factor must be the same (although opposite in sign for both gear wheels). Profile and flank modification is not permitted on the sleeve. Crowning and circular profile modification, with the center point being automatically calculated, is applied to the pinion.

Once defined, both primitives are directly accessed by the Spline Coupling Force Element FE 242, [Fig. 3]. Handling is similar to that of the Gear Pair Element FE 225. This ensures that the 3D visualization corresponds exactly with the calculation. Due to the necessity of crowning and correct calculation of angular alignment moments, slicing must be used. All other input parameters are similar to the Gear Pair Element with the added ability to apply not just coulomb friction but also viscous friction. Output values are also grouped into basic and visualization data, enabling users to easily reduce file output size.

CONCLUSION

The SIMPACK Spline coupling element is another new major functionality in the further development of SIMPACK for drivetrain applications. Linear and non-linear dynamics due to the implementation of detailed spline couplings can now be easily investigated.

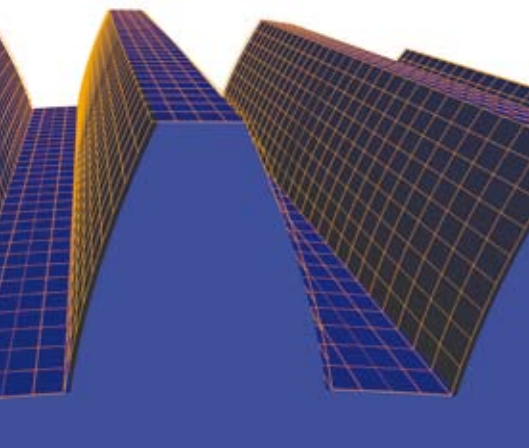


Fig 2: Tooth crowning

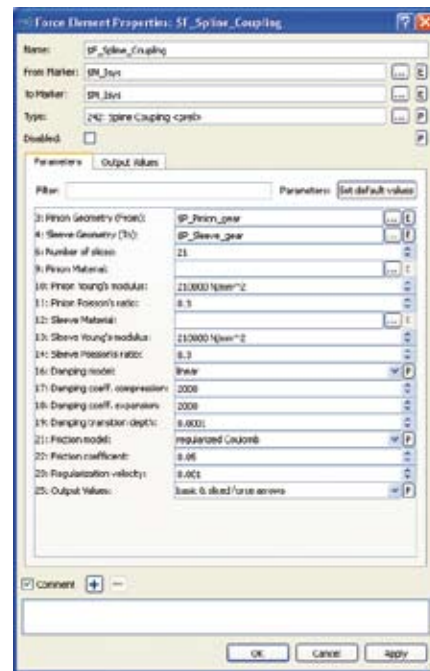


Fig 3: Input parameters FE 242