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Virtual Physics

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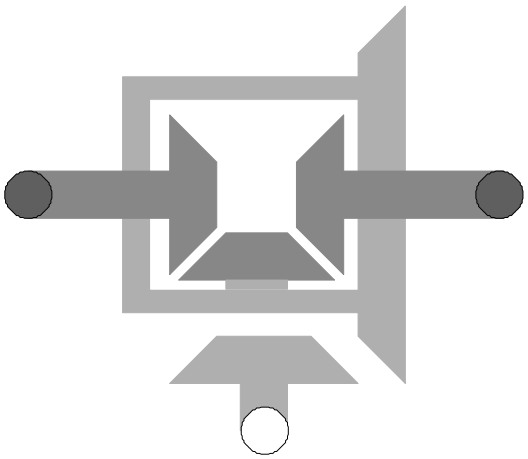
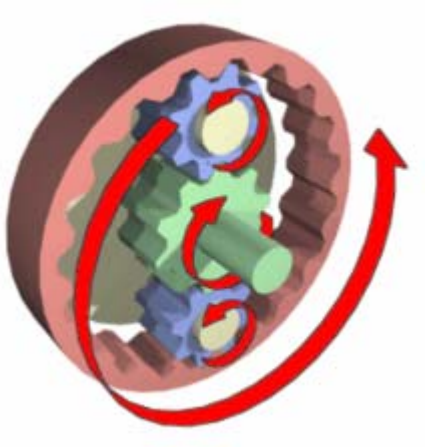
Exercise 6: 1D-Mechanics: Differential

Solution



A differential gear can be regarded as a special case of the planetary gear. The planetary gear essentially consists in three gear wheels, the ring wheel, the sun wheel and the planet wheel. The planet wheel occurs mostly multiple times, but that is irrelevant for the kinematics. Relevant is the ratio of teeth of the ring over the sun teeth.

ratio := ring_teeth / sun_teeth



A model of the planetary gear is included in the Modelica Standard Library. Its equations are:

$$(1 + ratio)*planet.phi = sun.phi + ratio*ring.phi;$$

$$ring.tau - ratio*sun.tau = 0;$$

$$planet.tau = -(1 + ratio)*sun.tau;$$

If we assign a ratio of -2, we get the equations of the differential gear. The sun and planet represent the left and right axis and the ring is the drive-wheel.

Consequently, the full equations for the differential are:

$$left.phi + right.phi = -2*drive.phi;$$

$$drive.tau + 2*left.tau = 0;$$

$$right.tau = left.tau;$$