OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

FACT SHEET

MSSE Measurement Science and Systems Engineering Division

ROBOTICS AND ENERGETIC SYSTEMS RESG GROUP

High Payload Holonomic Omnidirectional Mobility Based on an Off-Center In-Line Omnidirectional Wheel (OCILOW) Topology

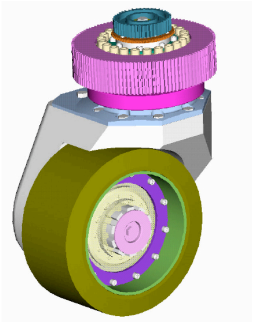
A variety of omnidirectional wheel configurations exist and ORNL has investigated and experimented with almost all of them over the past 15 years. It can be shown however, that there are only three basic wheel topologies that offer the potential for holonomic omnidirectional mobility: the Ilonator (sometimes referred to as Mechanum or Swedish rollers) wheels; Orthogonal wheels and the Off-Center In-Line Omnidirectional Wheel (OCILOW). While the Ilonator and Orthogonal designs are relatively simple to control and have been demonstrated on a variety of platforms, significant inherent limitations in these topologies hamper their usefulness on platforms that must move large payloads. On the other hand, the nature of the OCILOW configuration offers a solution to the fundamental limitations of the Ilonator and Orthogonal wheel designs, but advanced control methods are required in order to make this arrangement work properly. Until recently no one had successfully demonstrated a platform capable of carrying high-payloads using an OCILOW arrangement.

The platform, shown in the figure to the right, was developed for the U.S. Navy to demonstrate the enabling technologies required for high-payload holonomic omnidirectional mobility using an OCILOW topology. The platform has a 2:1 payload-to-weight ratio and a 10,000-lb payload capability. It can operate in its holonomic omnidirectional mode at speeds up to 1 mph (m/s) and in its "conventional steering" mode at speeds up to 4 mph (m/s). While intended primarily as a proof-of-principle system, it is outfitted with an assortment of safety and performance features, some of which are listed in the following table.

ORNL OCILOW transporter.

ORNL OCILOW platform features include:

- Payload 10,000 lb
- Weight 4,900 lb
- Endurance: 8+ hrs (regenerative braking)
- Safety: Teleoperator failsafe operation
- Stability: 30° static slope
- Mobility
  - General: come-along with speed modes
  - Brakes: 30° static slope
  - Positioning resolution: ±0.25 in, 0.5°
  - Obstacle negotiation: 2+ in steps and gaps; ±15° ramps
  - Towable
- Number of powered wheel sets: 4



ORNL Off-Center In-Line Omnidirectional Wheel.

Inherent advantages of the OCILOW design over other holonomic omnidirectional topologies include:

- Conventional wheel design
- Lower cost and better RAM
  - Simpler mechanical design
  - Off-the-shelf components
  - Increased tire life
- Larger diameter rolling surface
  - Higher payload capacity
  - Increased traction
  - Better obstacle negotiation
- Safer – no loss of control with two-wheel traction
- Degraded mode capability ("graceful" degradation from 4 to 3 to 2 wheels)
- Upscalable to greater payloads (by orders of magnitude)

OCILOW transporter with nearly 11,000 lb payload.

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