067-ENGR

Eliminating Jerking in Zero-Turn Mobility: A Uniball Wheel Design Approach

This project addresses the challenges posed by caster wheels in industrial and general operations, where heavy loads, confined spaces, and portability demands are common. Caster wheels play a critical role in maneuverability across various applications, from light-duty loads in computer chairs, to medium-duty loads in shopping carts and wheelchairs, to heavy-duty industrial casters that handle up to 5000 lbs. These wheels often cause abrupt shifts in motion, particularly in zero-turn environments. This issue, prevalent in applications like wheelchairs and other wheeled devices, results from the caster turntable design, which can lead to unintended reorientation. This reorientation causes a dramatic jerking motion which can be a critical and unintended when in a sensitive device like a wheelchair. The lateral velocity of the wheel will create a rotational movement because of the offset distance, thus inducing a reorientation of the wheel. The aim of this project is to eliminate these jerking effects by designing a uniball wheel that maintains seamless directional changes aligned directly with the axis of travel in all directions, without additional movements. The proposed solution integrates principles from mechanical engineering, leveraging 3D CAD modeling, computational analysis, and prototyping to validate, calculate, and test the design. Appropriate selection of materials for the new wheel provides optimal friction, durability, and ease of movement, ensuring that the system is effective while preventing scratching or unnecessary wear on surfaces. The tests and evaluation are carried out using static modeling and machine element design modeling to analyze the load distribution when stationery, and dynamic modeling for evaluating the wheel's performance during movement. These models help predict how forces will affect the wheel in real-world scenarios, providing essential insights into how best to design the new mechanism and what to expect from the simulations. Through the integration of mechanics, machine element design, and best engineering practices it is ensured that the wheel design is both practical, safe and efficient, and offers a smoother and more intuitive zero-turn experience. Thus, solving the mobility problem effectively, enhancing user mobility, and ensuring operational efficiency.

*Keywords: uniball, optimal friction, static, dynamic, machine element, materials, mechanism

**Funded in part by 2024 CUREs Mini Grant