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Ohno: Slow-Motion Precision Engineering for the Visualization of Earth's Tectonic Drift

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ABSTRACT

The Ohno project is an interactive art installation designed to make extremely low speed displacements visible to an audience. Although developed as a stand-alone artwork, it is a proof of concept and feasibility for a larger-scale installation called "A Second Wegener Harp", intended to be installed on a transforming tectonic fault, to reveal its movements through a perceptible optical phenomenon. Ohno evokes this geological-scale dynamic process by transposing in a perceivable experience the controlled motion of a platform that moves at the speed of the fault – or, more precisely, at the relative speed of the plates on the two sides of the fault. The core complexity of this project lies in the need to achieve ultra-slow motion transmission while ensuring that the system remains mechanically precise and responsive to environmental constraints.

The mechanical challenge of the system is addressed through an extreme transmission ratio that allows motion at scales comparable to tectonic drift, ranging from 0.5 cm to 10 cm per year. To achieve this, a highly efficient speed reduction mechanism was designed, integrating a multi-stage harmonic drive and custom worm gear transmission, enabling micro-displacements while maintaining structural rigidity and minimizing backlash. The system is servo-controlled to ensure continuous and uniform motion, compensating for external disturbances such as vibrations induced by audience movement in the exhibition space.

A second major challenge lies in the visualization of motion at a scale beyond human perception. To achieve this, Ohno integrates an onboard Michelson interferometer that projects the minute displacement of the platform onto a distant surface. By exploiting optical interference principles, the installation amplifies the motion, creating a dynamic visual representation of tectonic activity. The choice of a Michelson interferometer ensures both precision and clarity, allowing the audience to perceive the displacement in real-time through shifting interference fringes. Experimental calibration has demonstrated that the system achieves high accuracy, making the installation not only an artistic experience but also a highly precise metrological demonstration.

Early tests validate the feasibility of the approach, demonstrating that the transmission system maintains a controlled motion, while the interferometric projection successfully magnifies displacement, rendering it perceivable to the audience. This project presents an innovative intersection of mechanical engineering, optics, and artistic expression, offering a unique medium to explore the hidden forces shaping the Earth's surface. The results suggest potential applications beyond art installations, including geophysical education and studies on slow-motion mechanics.