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Experimental investigation of the Malkus-Lorenz waterwheel GEORGE RUTHERFORD, RICHARD MARTIN, Illinois State University — The Malkus waterwheel is well-known as a simple mechanical system that can exhibit chaotic behavior. Our experimental version of this wheel consists of 36 cylindrical cells placed around the edge of the tilted wheel. Water leaks from each cell through a long outlet of small diameter. A thin aluminum ring at the periphery of the wheel passes through variable gap magnets, allowing for adjustable eddy-current braking that is used as the control parameter. We acquire angular time series data with a rotary encoder, and we then smooth the data and calculate angular velocity and acceleration using Fourier transforms. Experimental results are compared with a model by Strogatz, and significant differences will be discussed. We will also show the results of the application of Gottwald's 0-1 test for chaos to the data, which indicate that all data at brake strengths higher than the period doubling cascade are chaotic. Preliminary data will also be presented that indicate that the total mass of water in the wheel does not approach a constant as assumed in the model.

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