C49 The Characterization of Binary-Output Walkway-Safety Tribometric Instruments by Characteristic Functions

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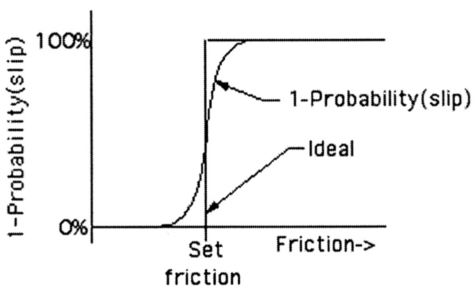
After attending this presentation, attendees will learn about using logistic regression parameters to characterize the response of binaryoutput tribometers. This information can be used to determine if different tribometers give equivalent results.

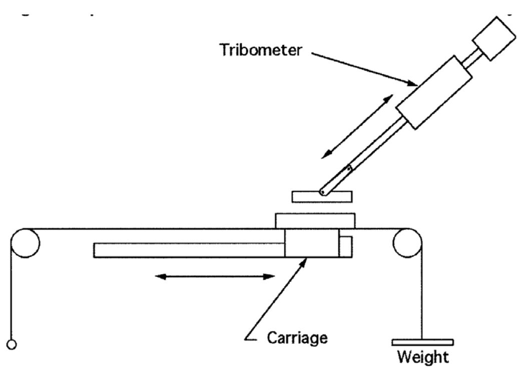
This presentation will impact the forensic community and/or humanity by demonstrating a method of characterizing walkway safety tribmeters that give binary, i.e., slip/no-slip results. The characterization gives insight into the accuracy and repeatability of the tribometer.

One way of broadly characterizing tribometers is to classify them as to whether they give a quantitative or a binary output. A drag sled, for example, gives a quantitative output (the measurement of the relative lateral force is an indicator of the friction). The Portable Inclinable Articulated Strut Tribometer (PIAST) is an example of a tribometer that gives an output in binary form. The carriage is set and locked at a given slip angle and the test foot is released. Either the test foot slips or it does not slip (and hence, the output is binary). Ideally, the tribometer will slip 100% of the time at available-friction values below the 'set' friction value and never slip at available-friction values at or above the set friction. (The 'actual friction' is a function of the friction measuring system, so comparisons of characteristic curves generated by different types of tribometer should be approached with caution.)



As with any idealized phenomenon, what we observe in fact is only an approximation to this idealization. What actually occurs is that there is no sharp-cornered vertical line delineating the slip/no-slip boundary. Depending upon the tribometer and the test conditions, the actual boundary has both a slant and rounded corners; at any given friction value near the actual-friction value, there is a finite probability, p, that the tribometer test foot will slip and a complementary probability, 1-p, that it will not.

A statistical tool that can characterize such situations is Logistical Regression (LR). LR uses the occurrence or non-occurrence of a qualitative variable (here slip or no-slip) as the dependant variable and a set of continuous parameters as the independent variable set. (Here, the friction of the tribometric system is the single independent variable.) Essentially, LR uses a least squares, maximum likelihood approach with the negative sum of the logs of the probabilities attributed to the response levels that actually occurred at each observation. (Note that, because all probabilities are between 0 and 1, all the logs are negative.) The regression parameters can be used to characterize the tribometric system.



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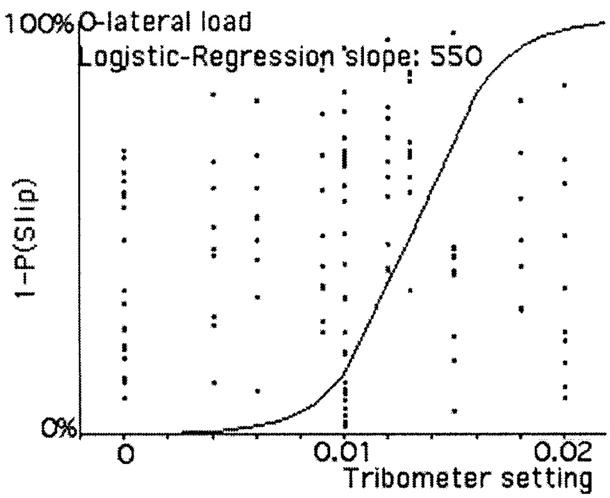
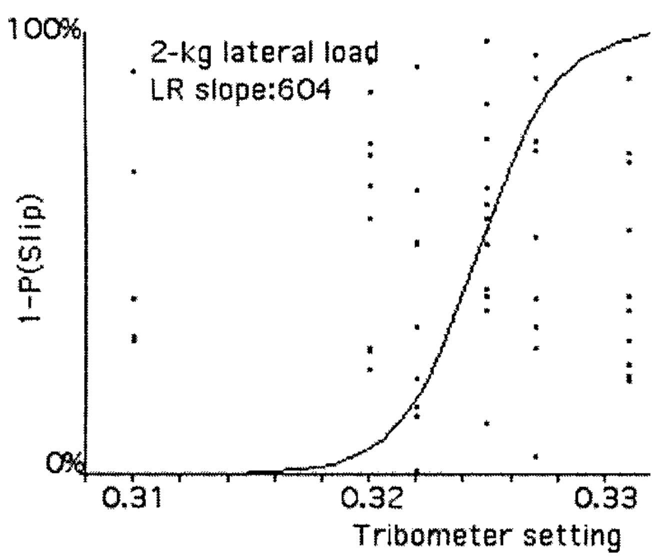
The experimental set-up is as follows (all stationary parts except the platform rail have been omitted for clarity). A level platform is constrained to move in a rectilinear fashion by low-friction instrument bearings bearing against a platform-support rail. To this platform, attached by string and pulleys, is a counterbalanced weight platform. When the platform is weighted to simulate a lateral force, it rests against a stop; the tribometer exerts a lateral force in a direction opposite that of the force exerted upon the platform by the weight. When the tribometer is released, the test foot contacts the platform, which is covered with double-stick tape, so as to eliminate all lateral force except as provided by the weight and the dynamic effects of the tribometer. The tribometer is set at a given level and repeatedly released. The dependant variable is recorded for each trial, i.e., slip/no-slip. The tribometer setting is varied and the process repeated. The weight is varied from the point where the carriage slips each and every time to the point at which the carriage never slips. The resulting data is analyzed using logistic regression. (Vertical load = 5.23 kg.)





Forensic Engineering, Walkway-Safety Tribometer, Slip-and-Fall Accidents

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