technical proof

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TP A.9
Cue stick accelerometer measurements

supporting:
"The Illustrated Principles of Pool and Billiards"
http://billiards.colostate.edu
by David G. Alciatore, PhD, PE ("Dr. Dave")

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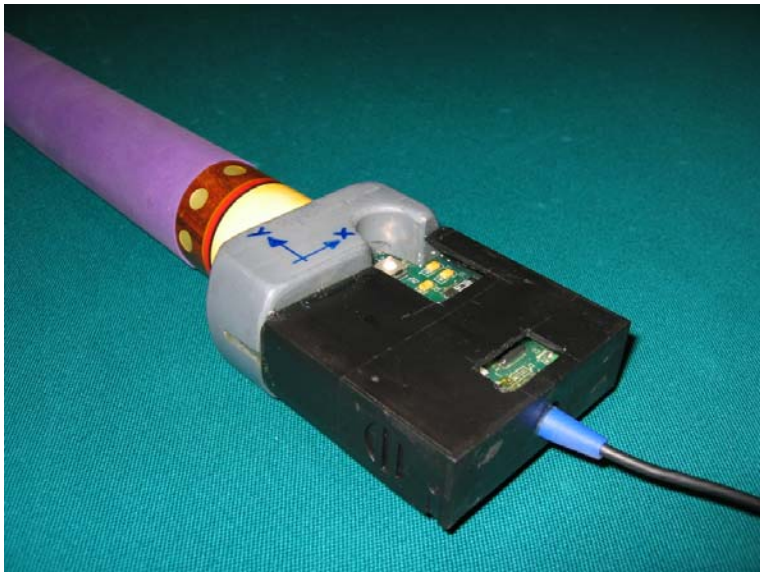
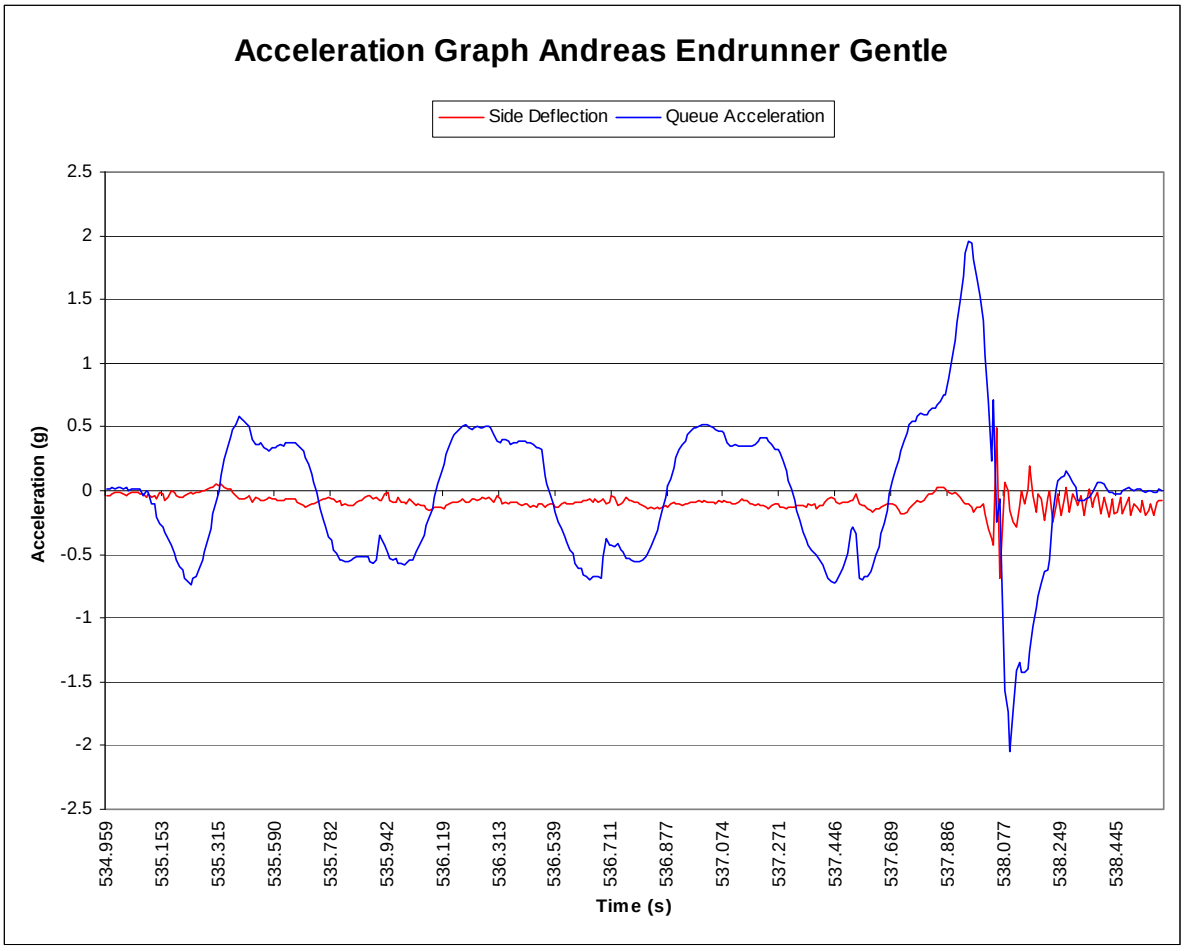
These plots below are courtesy of the Billiard SportKlub Union out of Austria (**http://www.bskunion.at**). The shots were performed by Andreas Efler, an Austrian three-cushion professional.

The photograph below shows the equipment used to take the measurements. A two-axis accelerometer is mounted to the butt end of the cue stick. The sensor measures acceleration in the cue stick impact direction (Y) and in the sideways deflection (squirt) direction (X). Acceleration is the rate of change of speed. When the acceleration is positive, the speed is increasing; when the acceleration is negative, the speed is decreasing; and when the acceleration is zero, the speed is constant.

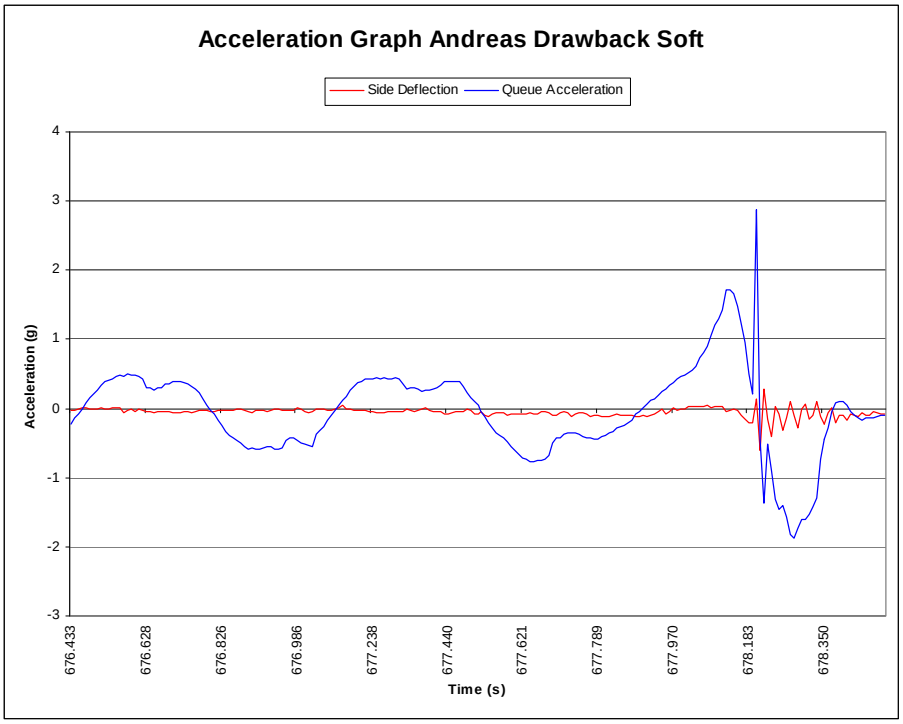


In the plots below, the blue curve represents the cue stick acceleration in the impact direction and the red curve represents acceleration in the sideways direction. The beginning humps in the blue curve represent the practice strokes. When the acceleration is positive, the cue stick is speeding up in a forward swing (or slowing down in a back-swing). When the acceleration is negative, the cue stick is slowing down in a forward swing (or speeding up in a back-swing). Notice the peak in acceleration just before impact. This corresponds to a big increase in forward speed in the final stroke. At impact, the acceleration goes negative, corresponding to a drop in cue stick speed. The positive acceleration hump after impact probably corresponds to the hand grip responding to the slowing that occurred at impact (see HSV A.34). The spikes in both curves during impact are probably the result of shock waves. The oscillation in the red curve after impact corresponds to vibration of the cue stick.

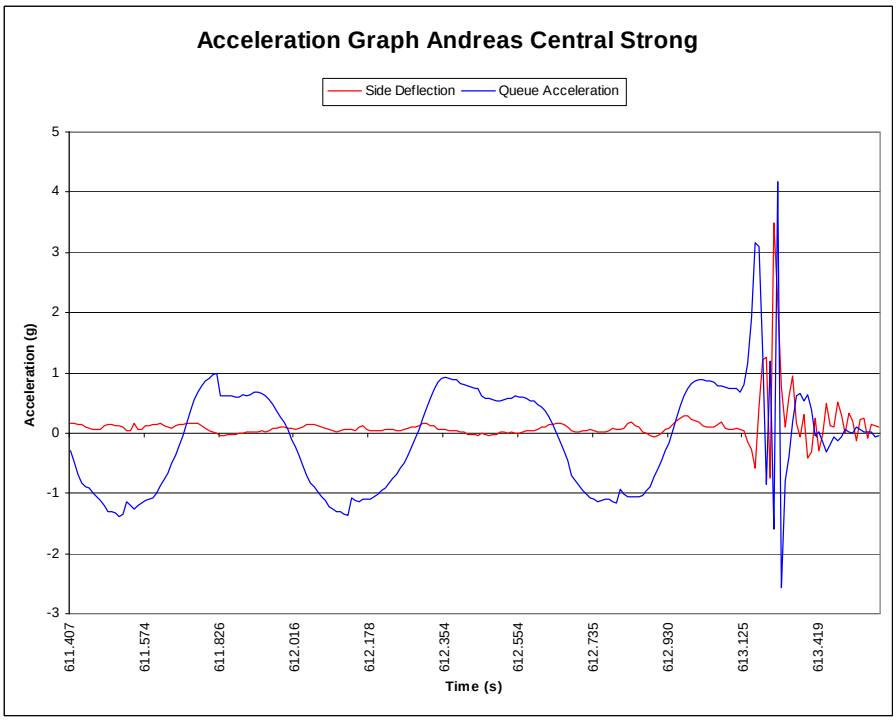
soft follow shot:



soft draw shot:

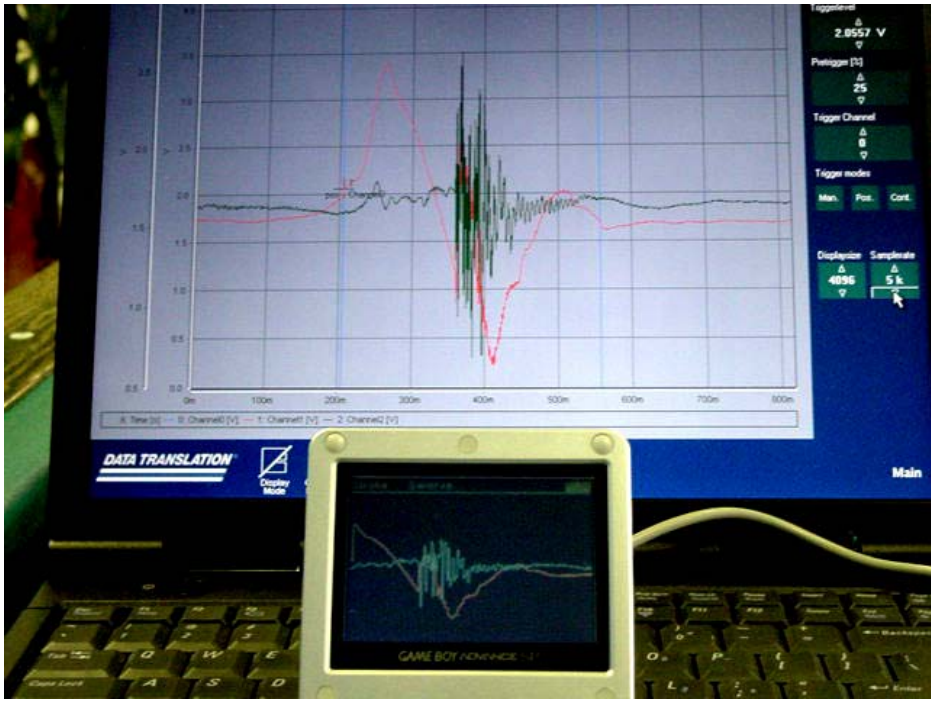


firm center-ball hit shot:

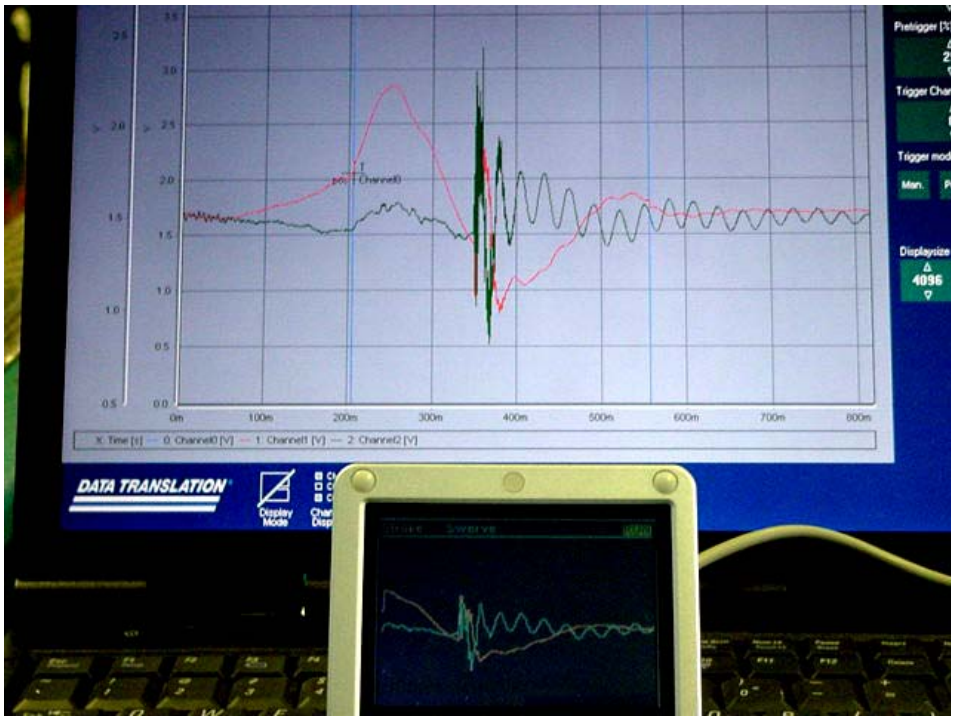


Here is some data from another source (John Pizutto). For more info, see:
http://jandssafeguard.com/PoolGizmo/Stroke-Alyzer.html

center ball hit:



off-center hit:



Notice the "ringing" in the sideways acceleration of the cue stick well after impact.