Relationships between Curling Rock Rotational and Translational Velocities, and Resulting Displacements, at Low Throwing Speeds

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A Prototype Rock Launcher (PRL) was developed to provide controlled curling throws at preset initial translational and rotational velocities. The purpose in designing this device was to facilitate research in curling dynamics, to help optimize sweeping technique, and to calibrate curling rocks and curling ice. This abstract describes an experiment where a curling rock was thrown down the center line by the PRL at various initial rotational and translational velocities to see how these variables interacted to produce different displacements down the length of the ice sheet (down-ice displacements) and displacements relative to the center line of the ice sheet (lateral displacements) as the rock completed its curved trajectory.

Initial translational speeds were set at 0.38, 0.76 and 1.26 m/s. Rotational speeds were set at 0, 27.7, 55.4, and 83.0 degrees/second (all clockwise). All combinations were tested at least 3 times in random orders. Pebbled ice was conditioned before testing. The PRL position was fixed. Sliding distance was measured using a laser.

The curling physics literature [1-5] has examined the relationship between rotation speeds (total turns) and lateral displacement, as well as translational speeds and down-ice displacement. It has not looked at the relationship between rotation speeds and down-ice displacements, nor translational speeds and lateral displacement. It also has not investigated interactions between translational and rotational speeds and these displacements. Results from the current experiment suggest a nuanced relationship between launch velocities and resulting displacements. Over the tested ranges of translational and rotational velocities, curl (lateral displacement) does correlate with down-ice displacement when the rock is launched with some rotation (see Figure 1) i.e. there is not as good a correlation when the rock starts with no initial rotation. When the rock is launched with some rotation, the nature of the correlation may depend slightly on the rotation speed (less translation at relatively low rotation speeds). Also, the rotation speed has no significant effect on down-ice displacement over the tested range. Further analyses showed that down-ice displacements decreased gradually over time (over the conducted trials), reflecting the experience of competitive curlers as ice gets worn down over the course of a game.

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Note that the PRL is not capable of full-speed competitive throws, which normally are ≈3 m/s at the point of release for fast takeout shots. Maximum down-ice displacements for these experiments were ≈9 m versus the displacments of more than 35 m that are common in a typical curling game. As such, conclusions should not be extrapolated beyond the tested conditions. Future prototypes will use better motors to expand the range of translational and rotation throw velocities.

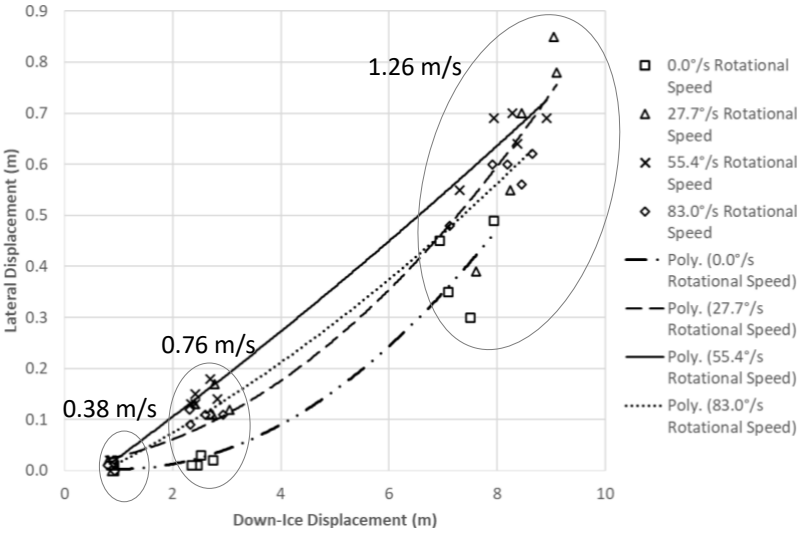

Figure. 1: The relationship between curl (lateral displacement) and down-ice displacement. The 3 circled groupings of data correspond to translational throw velocities of 0.38, 0.76, and 1.26 m/s. Different markers and fit lines correspond to initial rotational velocities of 0, 27.7, 55.4 and 83.0 deg/sec. All best fit lines are second order polynomials (R^2 values of .94, .96, .99 and .99, respectively).

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