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Arrow flight and optimal feathers in archery TOM MADDALENA, CAROLINE COHEN, CHRISTOPHE CLANET, LadHyX, Ecole polytehcnique — In archery, athletes shoot arrows with their bow from 70 m on an outdoor field. The target is made of 10 concentric rings, from 12 cm to 1.20 m. Therefore, the angular tolerance of the smallest ring is $0.12/70 = 2$ mrad. What is more, the environmental conditions such as wind or rain can have a huge impact on the arrows final position. Yet, a few centimeters on the target often distinguishes the winner from the others. All parameters of the bow and arrows must then be carefully selected in order to maximize the accuracy. In this work, we focus on the arrows flight, and more particularly on the choice of the optimal feathers. Archers can indeed choose among many size and shapes of feathers, and the effect of those feathers on the accuracy is still poorly understood. To tackle this question, we combine different experiments. We first shoot arrows with feathers of different size and shape with a throwing machine. Those experiments are eventually achieved with a lateral wind. We also characterize in a wind tunnel the influence of the feathers on the aerodynamic forces on the arrow. Those experiments combined with a theoretical model of the flight, allow to predict the trajectory of an arrow, and the influence of different perturbation on its final position.

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