4 Stalling

This fourth blog in my refresher course on the science of dart flight will be taking a look at something I should maybe have discussed in a bit more detail the first time around, the phenomenon of aerodynamic stalling.

In my last blog, “3 Degrees of Incidence”, we saw how, for a dart flying reasonably straight, say at up to around 15 degrees “incidence” (angle to its direction of travel), lift, not drag, was by far the most important aerodynamic force.

If dart flights were like most aircraft wings, around 15 degrees incidence would also be where they were beginning to “stall”, which means the lift they produce starts decreasing whilst their drag increases. In an aeroplane this may lead to catastrophe as it can start to fall out of the sky, in a dart it would result in the rather less drastic but still undesirable consequence of a less predictable flight pattern.

Such reduced predictability may lead to small changes in the release angle of a dart making a comparatively large difference in the angle it hits the board (something akin to the mathematical definition of “chaotic behaviour”). Darts stalling in flight is thus not conducive to accurate and consistent play.

To help overcome stalling, especially at the low speeds of take off and landing, modern aircraft can feature anti-stall devices such as flaps at the trailing edge of the wings, slats or slots at the leading edge, and winglets at the tips. The aerofoil cross-section of the wing itself is also a help in this regard.

Dart flights, however, customarily sport no such features. So does that mean those who "shoot their arrows in the air" (as Longfellow might have said) at incidence angles greater than 15 degrees (and that includes some professionals) are dooming them to stall, resulting in there being a fraction more "I know not" about where they "fall to earth"?

Fortunately for such players, there is a mitigating factor here in that dart flights aren't like most aircraft wings as their "aspect ratio" (basically their width divided by their length) is much less, which helps to increase their stall angle significantly. If required, yet more can be achieved by using flights with a delta "planform" (shape), which has a higher stall angle than a more conventional wing shape.

An example of this effect was demonstrated by Concorde, where delta planform wings were used to allow both supersonic flight and landing at high incidence angles – so high, in fact, that Concorde had to have a droop nose to allow the pilot to see the runway.

Of less general interest, if more relevance here, is that delta planform flights are used on Sigma darts, where they help to provide precisely controlled flight characteristics even when the dart is released a little waywardly..

Another fun fact (using an admittedly questionable definition of the word "fun") is that these flight characteristics are also not dependent on throw speed, but exactly why this is will just have to wait for another time!