Were Team GB's skeleton suits responsible for fantastic three medal haul?

February 19 2018, by Nicholas Martin

A streamlined Lizzie Yarnold sliding her way to gold. Credit: Singer/EPA

Team GB skeleton rider Lizzie Yarnold won a stunning Winter Olympic gold on February 17, backed up by bronzes for Laura Deas and Dom Parsons. Thanks to drag-resistant ridges, 3-D laser scanning and topnotch material, Team GB's skeleton suits are said to have provided up to a one-second advantage per run over the rest of the field and have been a hot topic of controversy.

What makes these revolutionary suits so speedy – and just how important were these technological innovations in Team GB's riders' success? The Conversation put these questions to Nick Martin, senior lecturer in Aerodynamics at Northumbria University.

How do the suits give the riders their extra speed?

The aerodynamics of a skeleton bobsled and rider are complex, and our knowledge of fluid mechanics is far from complete. This creates opportunities for research and development programmes that push the frontiers of our aerodynamic understanding to produce technological innovations that give riders an all-important edge.

Drag is the aerodynamic force that opposes an object's motion through air and slows it down. Only about 10% of the drag force acting on skeleton riders comes from the bobsled, meaning that the greatest potential for improving the time it takes to traverse the 1,376.38 meter track in Pyeongchang is to optimising the aerodynamics of the athletes themselves.

The drag acting on the riders comes from two sources. Air moving close to the athletes' bodies moves slower than air further away, causing friction along the athletes' skin suits. In addition, as athletes move down the track, air directly in front of them becomes more compressed and air behind them becomes less dense. This pressure difference acts to both "push" against the athletes from the front and "pull" them back at the same time, slowing them down.

Pressure drag accounts for more than 90% of the overall drag on both the rider and bobsled. The amount of pressure drag is influenced by the shape of the athlete, so aerodynamics experts can most effectively attempt to make performance gains by refining the athletes' helmets and suits.

Skeleton suits are made out of an elastic material called polyurethane. All teams use this material, but the addition of drag-resistant ridges and the use of 3-D scanning allows the suit designers to make subtle changes to the athletes' shape that seems to set apart Team GB's suits. This fine tuning is comparable to the careful design engineering of Formula One cars and aeroplanes to perfect their aerodynamic behaviour.

The drag-resistant ridges on Team GB's suits introduce turbulence into the thin layer of air surrounding the athlete, known as the boundary layer. A turbulent boundary layer actually causes more skin friction, but is less likely to separate when it encounters a seam in the skin suit, a folded ridge of material, or a curved surface. Separation creates pockets of low-pressure, slow-moving air, too much of which can cause large increases in pressure drag. The ridges minimise pressure drag, surmounting the increased skin friction to provide the riders with that extra bit of oomph.

Any loose "flapping" material from the riders' skin suits also causes air separation. By 3-D laser scanning athletes, the suit manufacturers can create bespoke, close-fitting suits for each rider, reducing the amount of loose material. 3-D scans can also be used in computer simulations to model how air flows over the rider and bobsled in order to analyse where any improvements can be made.

How much of a speed advantage do you think the suits provided?

A very liberal estimate of a 5% reduction in pressure drag would result in an approximate time saving of less than half a second. Most of the drag savings can be made just by an athlete having a sensible, close-fitting skin suit, which most of the athletes already have, further reducing the benefits of the ridges and 3-D scanning.

So, the claims of a one-second advantage are exaggerated. But from my experience working in Formula One, it is marginal gains of fractions of a percent that can make the difference to the top athletes. Let's not forget that Laura Deas only took her bronze by a margin of 0.02 seconds.

Is this fair and if so, why isn't everyone using them?

The suits were checked by the sport's governing body and ruled to be legal. Technology plays an important part in sports science. If it is correctly regulated to allow all competitors to profit from it, then this is a good thing.

The research that goes into drag reduction techniques could well be transferable to other engineering disciplines, which could have a benefit to the wider society.

I think that this is just an opportunity missed by other teams. Team GB has clearly invested in the technology aspect of sports. I would like to see more open funding for this type of research, so that more athletes can benefit.

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