How does the Lexus hoverboard actually work? A scientist explains

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Riding on air. Credit: Lexus

Marty McFly wouldn't be surprised. Lexus recently announced it had fulfilled the dreams of Back to the Future Part II fans everywhere by building a working hoverboard. And just in time for the October 2015 date that Marty visits in the film to discover kids have ditched skateboards in favour of their flying counterparts.

The Lexus "Slide" hoverboard isn't set to go on sale but a prototype was recently put through its paces by pro-skateboarder Ross Mcgouran at a custom-built skate park in Barcelona. Now Lexus has also revealed how the device actually works, involving a special track that enables the board to magnetically levitate above it, in a very similar way to maglev trains.

It's an amusing coincidence that, while Back to the Future featured technology called a flux capacitor, the Slide relies on something called flux pinning, as well as a principle called the Meissner effect. And this all works because of something called superconduction.

A superconductor is a material cooled to a very low critical temperature that, when you run a current through it, experiences no electrical resistance (the material doesn't push back against the current). When a material becomes a superconductor it pushes away any magnetic fields inside it. This is known as the Meissner effect.

The Slide hoverboard contains a series of metal alloy superconducting blocks cooled to -197°C by reservoirs of liquid nitrogen. The track below contains three magnets that induce a current in the blocks, causing the Meissner effect to take hold and expel the magnetic field back towards the track in a mirror image.

These mirroring magnetic forces repel each other and so the board is lifted above the track. Even if someone stands on the board, the magnetic forces are strong enough to keep it levitating because the lack of electrical resistance in the superconductor means the magnetic field can adjust to deal with external pressure.

But another scientific phenomenon makes the hoverboard even more stable. When the cooling process is switched on and the blocks in the board become supercondutors, they effectively trap the lines of the magnetic field from the track. This causes the blocks to be pinned at a fixed height above the track, a process known as flux pinning, which provides much more stable levitation. Flux pinning ensures the hoverboard doesn't deviate either horizontally or vertically from the track.

As a proof of concept, the Slide shows that constructing a hoverboard with stable levitation is entirely possible. Sadly, before we get too excited, the technology looks unlikely to hit the market in the near future for several reasons. The current board weighs 11.5kg, including the superconducting material and the liquid nitrogen on board, making it rather cumbersome to carry. The liquid nitrogen also requires a top-up roughly every 10 minutes to ensure that the superconducting material remains at optimal temperature.

On top of that, the board currently only works at one custom-built skate park. Lexus hasn't disclosed the cost for this proof of concept, but it is safe to presume that superconducting blocks, supplies of liquid nitrogen and a custom-built park awash with permanent magnets could not have been cheap.

Despite these limitations – and as Lexus points out – nothing is impossible. It is entirely plausible to imagine similar parks and guide-ways being constructed as part of future smart cities. Perhaps the hoverboard could even offer a greener travel alternative within the city as well as a leisure activity. In years to come, we could well find ourselves topping up our boards with liquid nitrogen at city-wide charging points, just as we fill up our cars today.

Source: The Conversation

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