

Surfing the 3-D printing wave: the changing face of surfboard fin production

June 16 2017, by Marc In Het Panhuis, Andrew Warren, Buyung Kosasih, Dr Stephen Beirne And Julie Steele



Marc in het Panhuis demonstrating that surfers require fins in their surfboards for stability and control during manoeuvres. Credit: Jones Beach Boardriders Club, Author provided

To catch a sweet ride, surfers rely heavily on two things: the waves, and their board.

Surfers can order surfboards that are customised to their needs, or

choose from a range of pre-made boards, with little difference in cost. When it comes to surfboard fins, however, it's a different story.

Fins are aerodynamic foils that act like rudders while [surfing](#), usually attached to the rear bottom of the surfboard. Fins were once permanently glassed into the board, but these days almost all boards have a removable fin system.

Manufacturers of removable fin systems make exceptional products, but the current manufacturing process involves injection moulding, which is very expensive. This pushes it out of economic reach for most surfers looking for a customised fin.

Enter three dimensional (3-D) printing. We have developed, designed and 3-D printed [surfboard fins made from composite materials](#), and have built and trialled prototype fins with flexibility similar to those available in shops.

3-D printed surfing fins

3-D printing (or [additive manufacturing](#)) refers to a range of manufacturing technologies using computer-aided design and layer-by-layer, bottom-up construction.

Bypassing the need for conventional technologies – such as milling, turning or moulding – it's perfect for rapid prototyping and fabrication of custom-designed products. 3-D printing is ideal for building surfing fins.

Although using 3-D printing to make fins is relatively new, there are several examples available on the internet. Most of these have been produced on [FDM \(Fused Deposition Modelling\)](#) printers.

The market for fins

Fins never used to be disposable, at least not for most recreational surfers. These days, however, almost every surfboard (either custom made or bought from a shop) is sold without fins. The fins have become a separate commodity that surfers add to their surfboard. Many surfers use different fins on the same board depending on the wave conditions, such as stiffer fins for larger waves.

The surf retail scene has changed accordingly. [Shops have sprung up](#) that are now entirely dedicated to just selling fins.

Fin prices vary depending on the type of surfboard. High-end single fins for [longboards and stand-up paddle boards retail for up to AU\\$150](#). For shortboards fitted with a thruster (three fin) configuration, prices vary between AU\$50 and AU\$180.

Surfers wanting the option of surfing their board in either thruster or quad (four fin) configurations can pay as much as AU\$270 for a complimentary set of five fins.

Data on fin sales are not easy to find, but the annual revenue for the entire surfing industry is [estimated at US\\$ 7.3 billion](#). And given that the number of [Australians who surf is at least 750,000](#), the Australian market for fins is around A\$75 million per year (based on the conservative assumption that every year each Australian surfer buys at least one set of fins, worth A\$100).



Marc in het Panhuis with a custom-made board. Credit: Paul Jones, Author provided

Traditional fin production

Mass produced fins all use [some sort of moulding process](#) that involves injecting resin in combination with materials such as fibreglass.

Other options include using a honeycomb or hexagonal core that is incorporated in the moulding process. This can be further modified by strategically placing a skin of carbon, Kevlar or aluminium-coated fibreglass (texalium) on the fin during production. Commercial fins are usually composite materials.

3-D printed fins have been made using a wide range of thermoplastic polymers, such as ABS ([Acrylonitrile Butadiene Styrene](#)) and PLA

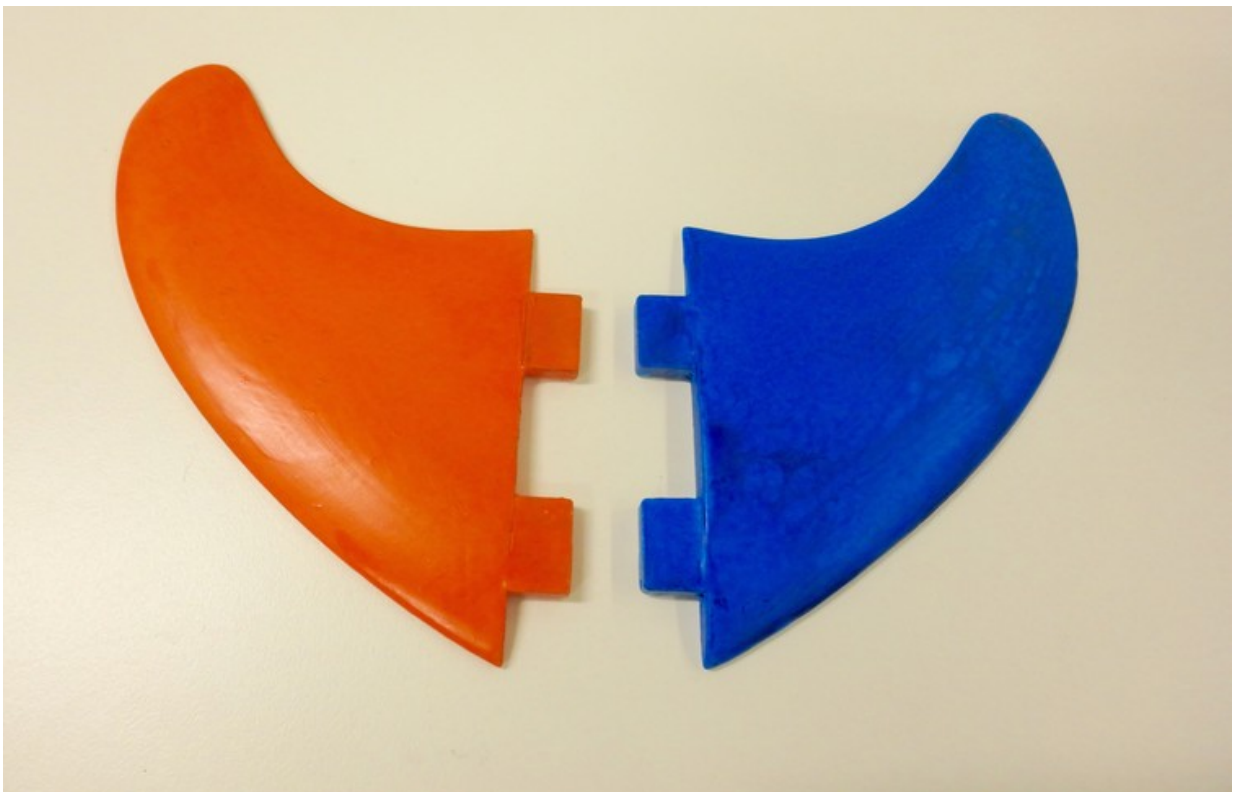
([PolyLactic Acid](#)).

However, the key is to use materials that offer the required material characteristics, such as stiffness or flexibility. We have found that composite, or mixed materials are required to produce 3-D printed fins with [similar flex properties to that found in commercial fins](#).

What surfers look for in fins

Fins in surfboards enable surfers to control the direction that their surfboard travels.

[The physics of this takes time to explain](#), but it essentially comes down to this: surfers look for a surfboard and fin combination that enables them to execute manoeuvres with speed, power and/or flow depending on their skill level.



3-D printed fins. Credit: Marc in het Panhuis, Author provided

3-D printing allows a surfer to tailor-make a fin suited to their particular style of surfing. Just like paying for a set of golf clubs fitted to your size and skill level, 3-D printing enables the fitting of fins to your surfboard, height, weight, ability and style.

In addition, surfers are thinking more and more about [sustainable solutions for the surfing industry](#). 3-D printers can easily incorporate recycled materials to print new fins.

Ready-made vs custom-built

There are surfers who like to buy ready-made boards, and those who order custom boards from shapers. With fins, this is likely to be similar.

3-D printed fins are for those [surfers](#) who like to control all aspects of their surfing equipment, and will suit those who feel it is important to have fins made to their exact specification.

3-D printed fins also offer advantages for developing personalised fins for surf therapy and adaptive (disabled) surfer programs, depending on the needs of the surfer. Personalised fins will allow for better stability, control and steering thereby enhancing the surfing experience.

3-D printing may even change [surfboard](#) construction. Recently, three-time world surfing champion [Mick Fanning rode waves using a 3-D-printed surfboard](#). While most of us won't achieve the lofty heights of [Australia's champion professional surfer](#), there may soon be a day when

every surfer will be able to insert custom made 3-D printed fins into a board, and take to the waves.

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