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### Title

## Recent Progress in Wrapped Tow Reinforced (WrapToR) Composite Truss Structures

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### Abstract

Wrapped Tow Reinforced (WrapToR) trusses are a family of ultra-efficient composite structures which are made with a low cost continuous winding process originally invented to create blade spars for the Gamera Human Powered Helicopter project. Wide-ranging research activities since then have significantly advanced the accuracy, quality, and geometrical adaptability of the manufacturing process while also exploring and improving, through numerical and experimental means, the mechanical performance of these structures. Parallel research streams have explored WrapToR truss beams, WrapToR-SHell truss reinforced skin panels, hierarchical space frames, truss joint connections, and an inverted form of the manufacturing process, known as Trusstrusion, which can continuously extrude truss beam structures. This talk will outline the history of the concept before overviewing recent progress, highlighting along the way the many promising results seen to date and outlining future research directions.



(a)



(b)

Figure 1. WrapToR trusses, a) a WrapToR truss beam (width = 33 mm) and b) the Gamera Human Powered Helicopter with a structure made almost entirely of WrapToR trusses, including a hierarchical space frame

The WrapToR concept is an adaptation of traditional filament winding wherein composite material is wet wound around a mandrel. This mandrel supports a series of premade composite tubes, typically three carbon fibre/epoxy pultrusions in a triangular arrangement, which form the longitudinal members of the truss. As the continuous composite tow is wound around these tubes, it forms a web of shear members which bond to the underlying longitudinal members. Crucially, this continuous winding approach creates incredibly light and stiff truss beams from as few as four parts, in a

few minutes and on relatively simple machinery. In this way, WrapToR reduces part count and manufacturing time by one to two orders of magnitude compared to a traditional truss assembly process.

## References

[1]