Additive manufacturing becoming a disruptive force in marine tooling

Jason Susnjara - THERMWOOD

A new line of Additive Manufacturing Systems for the production of large to very large reinforced thermoplastic composite parts is proposed by Thermwood Corporation, located in Southern Indiana U.S., manufacturing a broad yet extensive line of 3 and 5 Axis CNC Routers. The new machine line, called LSAM (short for Large Scale Additive Manufacturing), uses a two-step, near-net-shape production process. First the part is 3D printed, layer by layer, to slightly larger than the final size, then it is trimmed to its exact final size and shape using a CNC router. This system perform both printing and trimming on the same machine using two gantries, one for printing and one for trimming. Although suitable for producing a wide variety of components, LSAM is used for producing large to very large industrial tooling, masters, patterns, molds, and production fixtures for a variety of industries including aerospace, automotive, boating, foundry and thermoforming. The primary benefits of 3D printing production tooling are a substantially lower cost and a dramatically shorter build cycle. A 3D printed boat hull pattern, from which fiberglass boat hull molds are made, has been completed using a near net shape additive manufacturing process and then successfully used to produce

La produzione additiva rivoluziona la nautica

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Thermwood Corporation, ubicata in US, Southern Indiana e produtore di una linea estesa di router CNC da 3-5 assi, ha presentata una nuova linea di Sistemi Produttivi Additivi per la produzione di componenti in composito termoplastico rinforzato. La nuova linea, denominata LSAM (acronimo di Large Scale Additive Manufacturing), utilizza un processo produttivo a due fasi, near-net-shape. Prima di tutto, il componente è stampato in 3D, strato per strato, leggermente più grande della dimensione finale, poi viene rifinito fino a raggiungere l’esatta dimensione finale e forma con l’ausilio di un router CNC. Questi sistemi eseguono sia la stampa che la rifinitura sullo stesso macchinario con l’ausilio di due cavalletti, uno per la stampa e l’altro per la rifinitura. Nonostante sia adatto alla produzione di una vasta gamma di componenti, LSAM è utilizzato per la produzione di utensili industriali da grandi a molto grandi come dimensioni, master, modelli, stampi e accessori di produzione per molte industrie fra cui l’aerospaziale, automobilistica, nautica, fonderia e della termoformatura. I vantaggi principali della lavorazione per la produzione di stampa 3D sono i costi sostanzialmente inferiori e un ciclo di costruzione abbreviato. Un modello di carena stampata in 3D, da cui si ricavano gli stampi di imbarcazioni in vetroresina è stata completata utilizzando il processo produttivo additivo near-net-shape, poi successivamente usato per produrre uno stampo in vetroresina in un programma di valutazione congiunta a prova tecnologica.

LAVORO DI COLLABORAZIONE
Questo risultato è il frutto del lavoro comune
A production capable fiberglass mold in a proof of concept joint evaluation program.

**A COLLABORATIVE EFFORT**
This achievement was the result of a collaborative effort between Thermwood Corporation, Techmer PM and Marine Concepts. The tool was printed slightly oversized and then trimmed to final net size and shape using a large scale additive manufacturing (LSAM®) system. It was made from Techmer’s Electrafil® ABS LT1 3DP, which has proven ideal for marine tooling applications when processed using LSAM print technology. The entire print, assembly and trim process required less than ten working days to complete. After the printed and trimmed tool was coated and finished, a fiberglass mold was produced using Fra Thermwood Corporation, Techmer PM e Marine Concepts. L’utensile è stato stampato leggermente sovradimensionato per poi essere rifinito fino a raggiungere la dimensione e la forma finale utilizzando il sistema di produzione additiva su larga scala (LSAM®). E’ stato realizzato con Electrafil® ABS LT1 3DP di Techmer, che si è rivelato ideale per applicazioni di utensili in campo nautico durante la lavorazione con l’ausilio della tecnologia di stampa LSAM. L’intero processo di stampa, di assemblaggio e di rifinitura ha richiesto meno di dieci giorni lavorativi. Dopo aver stampato e rifinito l’utensile, è stato prodotto uno stampo in vetroresina utilizzando un modello stampato. Questo sforzo dimostra chiaramente la fattibilità, la praticità, l’economia e i vantaggi offerti dalla tecnica di produzione additiva nella realizzazione di un’imbarcazione.
Additive manufacturing offers the promise of even more advances in marine tooling such as printing the hull and deck pattern as a single piece, allowing a production mold to be taken from the hull and then flipping the pattern over and taking a deck mold from the other side of the same pattern. All of these possibilities result in dramatically lower tooling cost and substantially faster build time. For large boats and yachts, Thermwood is evaluating the feasibility of printing molds directly, rather than printing a pattern from which the mold is taken. Because of their large size, these tools will need to be printed and machined in sections, even with very large LSAM® printers. It may also be possible to print integrated cooling channels for air or liquid into these large tools as part of the print process. With this initial success and some radical new ideas that appear to be possible with current materials and technology, it is becoming apparent that additive manufacturing may very well represent a disruptive force for the marine tooling industry.

**THE DETAILS**

The final tool was printed in six sections, four major center sections with walls approximately an inch and a half thick and a solid printed transom and bow, which were pinned and bonded together using a Lord plural component urethane adhesive before being machined as a single piece on the system. The final trimmed pattern weighs approximately three thousand pounds. It required approximately thirty hours to print and fifty hours to machine. The demonstration machine, used for this program, has a 10 foot by 20 foot worktable and features both print and trim capability on the same machine. The print head used for this project can print at rates approaching 200 pounds an hour when running this particular Techmer material. Thermwood also offers larger machines and higher throughput print heads as part of its LSAM product line.

**ADDITIVE MANUFACTURING COULD CHANGE MARINE TOOLING PROCESS**

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