

## Nesting efficiency in the face of higher prices

For various reasons, many aerospace and automotive manufacturing companies have not improve on their nesting efficiency much over the last few years and, given recent price rises in sheet metal and composite materials, this is starting to bite. With composite materials being already expensive, recent double digit price rises by a major composite manufacturer have cut even further into margins. Those companies that employ a more efficient nesting method will gain considerably over their competitors, not only in the amount of material saved but also in the time taken to create the nests. So what can manufacturing companies do to improve their material utilisation?



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**D**ue to the high cost of raw materials, aerospace manufacturers have historically generated static nests manually, or used a computer aided nesting system and then spend time manually improving the resulting nest. These quite efficient static nests are used time and time again to produce specific kits of plies. There are, however several drawbacks to this method. Firstly, the length of time required to nest using a computerised nesting system and then manually intervene to obtain the required nest efficiency is significant, as manual nesting can in some cases add an extra day or two per nest pattern. There is another disadvantage in using static nests

- manufacturers will often overproduce when not all plies on the nest are immediately needed, when replacement plies have to be made for spares, or to replace plies that have been rejected due to quality issues. With static nest method, there obviously is a lack of flexibility to cut what is needed when it is needed, thus avoiding wasted material.

The other major issue is that many composite materials have a grain, meaning that they can often only be nested at fixed rotations of 0 and 180 degrees (possibly plus/minus a few degrees). As a result it has generally been difficult to automate the nesting process to take all of these factors into consideration and still generate efficient layouts.

### Composite cutting requirements

Cutting composite components differs greatly from, for example, cutting sheet metal components on a CNC laser machine. Unlike on laser or plasma cutter, no lead-ins, lead outs or tabs are required on a knife cutting machine, as plies are cut free and are held in place either by vacuum or gravity. However, as material is supplied on rolls, and frequently used on conveyorised machines, the nesting process needs to be managed carefully. Additionally, some materials have to be kept in a freezer and can only be held at room temperature for a relatively short length of time, so this needs to be taken into account when processing orders for nesting. Part identification with nests often being several metres in length and containing hundreds, even thousands of plies is necessary and there is also a need for material and its life management system linked to the nesting system itself, that can track:

- how much material is left on each roll;
- how many rolls of each material are in stock;



Fig. 1: The system has cut costs significantly for Embraer.

- the life left per roll, either new or that has previously been out of the freezer;
- which roll individual plies were cut from.

Obviously, this is very important in the aerospace industry where the need to maintain traceability is paramount.

## The Solution

The best way to overcome the above issues is to employ an advanced CAM system such as Jetcam International's Expert system, which can provide a very high level of nesting efficiency and automation, while avoiding the pitfalls associated with the use of static nests – a system that can store individual machine and material characteristics and user preferences and can intelligently apply them during the nesting and cutting process. For example, such system needs to understand the difference between machines that use a conveyor instead of a fixed flat bed table, because once the plies currently on the conveyor are cut, the material needs to be pulled forward, the cutting cycle continued across the reposition and so on, as the need to continue the cut, particularly for large plies can span across many repositions of the conveyerized table. Another example is a common need to add an 'oversize condition' to the periphery of a ply. On a modern nesting system this could be configured as a standard setting and applied automatically where and when appropriate.

Identification of individual plies in a nest is vital with composite cutting. This laborious task has traditionally been done by hand using a felt tip pen to mark the plies on the already cut nest. Later machines employed pen markers and now we see marking being done by an Inkjet marking head or by applying labels. With these automatic marker technologies all the plies on the nest can rapidly have their identification applied before the nest is actually cut. This dramatically speeds up the cutting process. With automatic marking it is also important to remember that text size and angle can change according to the size and orientation of the ply. Many plies can be long and thin and depending on their orientation, marking will often end up off the ply, should this not be taken into account. The next innovation in ply identification and removal from the nest in correct sequence is to use a laser identification system, i.e. the nesting system sends the nest and ply information to the Laser ID system which, when prompted by the operator will indicate the ID of the next ply to be removed, while the laser beam clearly points out the physical ply on the nest. This simplifies and dramatically speeds up the removal of plies from a nest and aids in correctly stacking the plies ready for the next operation.

Jetcam offers several options for nesting, with their free form high performance nester (FFHPN) being the most advanced in the world. The Jetcam system can be configured to run the nesting algorithm over a pre-specified time period to obtain the

highest nesting efficiency. Many users configure the system to queue jobs overnight across one or several Jetcam Expert systems, so that the computers have the maximum time available for nesting. When Bombardier Aerospace in Northern Ireland evaluated several new CAM systems Jetcam Expert's FFHPN system demonstrated material efficiency improvements of between 10-15%.

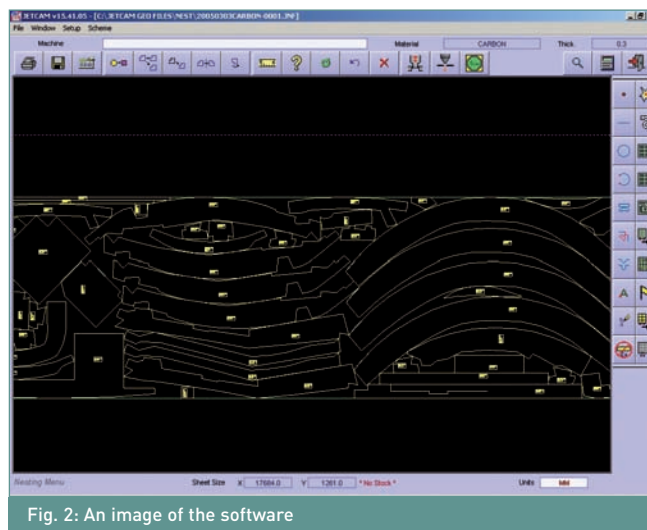


Fig. 2: An image of the software

## Full turn-key automation

A further level of automation can be achieved through integration into legacy production management systems using products such as Jetcam's Remote Control Processing (RCP) module, which integrates tightly between Jetcam Expert and the production management system. Jetcam's RCP module will fully automate the process from processing the orders supplied by the production control system, all the way to production of correct and efficient CNC program for the required machine(s). It will automatically process components using CAD geometry and corresponding PPI files, which can be produced by many CAD systems. A 'PPI' (pre-programmed input) file contains manufacturing information such as:

- #UNITS=<units> (This file is in MM or Inches)
- #MATERIAL= (Type and Thickness)
- #REVISION= (Revision Number)
- #CAD\_MOVE\_PATH= (Where to move processed CAD geometry)
- #PART\_NAME= (Component Name)
- #SKIP\_EXISTING\_PART= (Overwrite/Do not overwrite a part if it exists)
- #JOB\_ID= (JOB Identification)
- #ROT\_ALLOWED= (Component Rotations Allowed - Grain Control)
- #FIND\_BEST\_ANGLE= (to maximize nesting performance)
- #ROT\_ANGLE\_TOL= (allows for slight angular adjustment during nesting)

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- #USE\_CLUSTER= (Parts can be Clustered for optimal nesting)
- #MACHINE= (Specifies Machines(s) for which to program the part)
- ...and other (Many other optional parameters are available)

Once a part is processed, it is stored in the component database and, as it contains all necessary nesting and manufacturing information, it is now ready for nesting at any time in the future. A production control system (or other software for that matter, such as Jetcam’s Order Controller) can provide a queue of plies or whole assemblies which will then be automatically nested according to the machine(s), material type and other parameters. CNC code for the relevant machine(s) is generated and placed in pre-determined locations ready for the machine operators to use. All of this takes place without any operator programming or intervention.

Jetcam’s RCP “Black Box” approach is in operation in many general manufacturing, aerospace and automotive companies around the world. When coupled with FFHPN it provides a fully automatic nesting and CNC code generation system which delivers nests that are more efficient than even the best manually produced nests. Using RCP and FFHPN modules, Bombardier Aerospace in Montreal, Canada is making very significant savings in material every day, with Embraer in Brazil citing an overall material saving of 4% and a 6 hour per day saving on programming time. Several high end racing car manufacturers have also standardised on Jetcam Expert due to the material efficiency and automation it provides. With these levels of savings it is commonplace for a system such as this to pay for itself in a matter of weeks.



Fig. 3: A composite cutter used on the Embraer ship

## Evaluating a new CAM/Nesting system

There are three key areas that one should to consider when implementing a new programming/nesting system – 1<sup>st</sup> it should reduce material waste as much as possible, 2<sup>nd</sup> it should reduce

## Focus ...

Jetcam International develops and distributes the Jetcam Expert CAD/CAM and nesting software. With well over 5000 licenses in 70 countries, Jetcam Expert supports virtually every profiling and punching machine available today and produces highly optimised nests automatically.

programming time, therefore also possibilities for errors, 3<sup>rd</sup> it should optimise machine cycle time. The quality of the generated CNC code is also very important as it is this that is ultimately driving your machine! Requesting a benchmark comparison between selected vendors is an ideal way to gauge the efficiency and ease of use of each system. Select a nest of components and provide this, along with the separate component geometries to prospective vendors to produce a benchmark which you can use to compare against, and get them to run this benchmark in front of you so you can see how easy (or difficult) it is to produce an efficient nest. If grain is an issue, ensure that, say, plus/minus 1 degree rotation ‘freedom’ is specified during nesting so that the best efficiency can be achieved while grain restrictions are still taken into account – this can make a sizeable difference to the final efficiency percentage. Also make a note of the time taken to produce the nest – this can vary greatly between systems.



Fig. 4: An Embraer Bombardier in flight

## Conclusion

Any company that has a sizeable material spend can benefit considerably from re-evaluating their nesting processes. Taking the time to assess whether you can make even a 1% saving in material used could pay huge dividends and also have a side-benefit of giving you a path to a completely automated nesting process in the future. When evaluating a new system focus on the end goal of return on investment rather than simply comparing like-for-like features. ■

More information: [www.jetcam.com](http://www.jetcam.com)