

WHITE PAPER

i-cut[®] Vision and Graphics Finishing



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Introduction

There are a number of factors, separate from the quality of the CAM/CNC cutter/router/laser finishing device itself, that determine the profitability of a specialty graphics finishing application:

These are:

- Cut line accuracy and the minimization of scrap
- Ease of use and simplicity of set-up for finishing jobs
- Impact of workflow on the efficiency of the plant

To be certain, the integration of hardware in any plant is of paramount importance. If software products can be used to easily improve quality and improve multi-process manufacturing, the end user really reaps large rewards.



Typical display graphics

In this white paper, we will explain the rationale that makes i-cut® the market leading and most accurate vision solution for accurate digital finishing. We will also support its benefits by describing its tight integration into the typical printer's workflow process. These two elements make i-cut unique and the best decision for a specialty graphics printer looking to add digital finishing capabilities.

Cut Line Accuracy

Without consideration of each of these issues, purchase and use of the world's best CNC contour cutting and finishing hardware may be a waste of hard earned dollars!

It seems that market perception is generally true and has a way of becoming the conventional wisdom. However, when it comes to the market's interpretation of a technical issue, conventional wisdom should not be allowed to "rule" should it significantly distort the merits of something that is quite important to a user of that technology. One place where this situation exists is in the field of digital finishing, or what may be better known as "digital die-cutting."

Historically, the placement of rectangular images into a page presented production challenges, so the solution that was used for decades was to place each image into a border, so that any mis-

registration of the images boundaries would be masked, or hidden, by this border. This was fairly easy to accomplish in the print world. However, the problem is not so simple to mask when it comes to irregular shapes, especially if those shapes are going to be cut – as in die cutting.



Example of print distortion

Certainly, there are many shapes, in terms of complexity and size, for which a traditional metal die can be manufactured and used. And yet, many have received such die cut materials and found that the die line and the image were noticeably out of register. The human eye can resolve about one thousandths of an inch of white space. Therefore, even slight mis-register of a die can easily cause white space become to become visible and/or cut

off an important edge of an object. All of us have seen this and accept it as it generally comes with bulk advertising materials, but if it were a necessary point of purchase graphic, or a cut-out for packaging, for example, such inaccuracy would not be acceptable.

The Harley Davidson Story

Ten years ago, the Harley Davidson Company was rejecting about 30% the die-cut decals being produced for mounting on its fenders and fuel tanks. Their specialty graphics printer was printing work printing on 3M adhesive backed vinyl materials which heavily distorted during the printing and lamination stages. This printer was being pressured to reduce the scrap so that he could reduce their prices to Harley Davidson. It is easy to understand the problem:

vinyl is made to stretch around shapes to which it is being mounted. Unfortunately, this ability, so needed for its use, also meant that under different temperature and humidity conditions it also tended to change shape. This resulted in a die cutting challenge that was clearly beyond the then-available technology.



Typical decal for Harley Davidson

The solution to this problem seemed to be to find a way to look at every point on a die curve and determine its error from the expected curve. Through the innovative use of technology akin to a GPS system, i-cut's programmers were able to accomplish this task and make cut line changes on the fly so that Harley was now rejecting less than 2% of the work, and everybody was pleased with the savings.

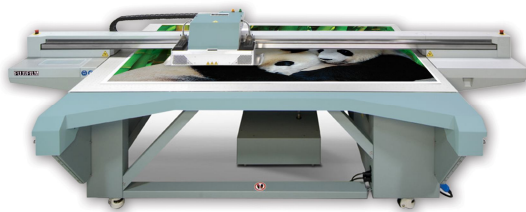
The next place where such correction of die lines became important was in the laminating of digitally printed roll materials onto rigid boards, from which cut out specialty graphics were required. Everybody in the marketplace seems to understand that the laminating process, forcing a print to adhere evenly to another substrate causes potentially major distortions to occur. Vinyl, and paper prints, in particular may be stretched and/or contracted in ways that significantly distort the images and do it in such a way that cannot be predicted in advance. In addition, distortion was kept to a minimum with screen printing by keeping print size small. Laminated materials, even at smaller sizes, are likely to have stretch in images that can easily be seen by the eye.

Graphics Printing Today

Screen printing, while still important, is not the majority place where digital die cutting is necessary. More than 70% of the market for die cutting is now printing that is done digitally directly onto both roll and rigid substrates. Roll materials, depending upon width and the complexity of the graphics can also exhibit similar issues. Small graphics are relatively easily cut using simple left/right registration, however, more complex and specialty graphics can be affected more from stretch (as in unequal roll tensions) and roll wander over longer graphical images, causing significant distortions that cannot be fixed without more sophisticated die line modifications. If you look very carefully at the kinds of graphical images show being cut on roll fed drum cutters at the major trade shows, for example, you should note that they almost always show and cut small graphical elements.



Traditional analog screen press



Modern digital flatbed UV press

Next, the emerging UV flatbed super wide format market must be addressed. There are many XY machine manufacturers who “believe” and publically state, that distortion is not a big problem when dealing with digitally printed images on rigid substrates. Unfortunately, this could not be further from the truth. I-cut has had many discussions with the printer manufacturers in which they admit that they are not able to get boards to run through the print cycle completely square. And, the customers certainly understand that depending upon the method by which the substrates are fed, and the overall accuracy and repeatability of the printer, there are certain kinds of jobs that require cut line compensation in order to finish them such that the human eye cannot see the cut line errors.

Certainly, there are differences in end to end register accuracy from the low end of the rigid printer market to the high end. Where machines costing over \$500K may incur errors of under 1/100th of an inch across a 4 ft. X 8 ft. board, other printers may exhibit errors greater than 1/8th inch. And, since the human eye can see 1/100th of an inch of white space, each of these needs some kind of cut-line correction to be fully accurate. In addition, each of the printer companies has focused upon speed and color accuracy as their barometers of success and has determined that these are the issues that sell printers.

We have not seen any printer company discuss repeatability and accuracy in the way that Heidelberg had to ensure tight register and such on its traditional offset presses. And, at i-cut, we know that the printers are not accurate enough because we get calls every day of the week from sign shops that have long used CNC routers who say, "until we started cutting printed signs, we never had a problem with our routers," but now they don't do a good enough job for our customers. "Can we add i-cut to our system?"

Print Distortion

All prints have distortion! When printed graphics are produced distortion is introduced into the printed results that make the original digital die line inaccurate for cutting. This distortion occurs with digital, offset and screen printing and can be due to the printing process itself, the media instability, variable roll tension, distortion during lamination, and more. With i-cut, your customer never needs to worry about the type of distortion, or the severity – it works for all!

i-cut offers five distinct types of distortion correction algorithms that accurately work for all types of applications:



Position - Positions all curves in all layers as one group. Size, shape and relative positioning of the curves all remain intact.



Position and Rotation: Positions and rotates all curves in all layers as one group. Size, shape, relative positioning and rotation of the curves all remain intact.



Layer Position and Rotation: Each object is produced at the exact size and shape defined by the file, but registered individually from all other objects in the file, compensating for positional and rotational changes that have occurred. Objects in each layer will maintain exact size, shape and relative positioning.



Linear Compensation: Applies a linear scaling factor based on the collected information. The size, shape, offset and rotation of all objects are altered in a linear fashion.



Non-Linear Compensation: Adjusts each individual point on every curve according to the positions its three closest register marks. This process compensates for offset, scale, rotation and skew of all objects in the file. Non-Linear Compensation offers the highest level of compensation available and provides the closest possible match of the cut path to printed graphic.

Evolution

Interestingly enough, if you have followed the evolution of other vision systems on CNC machines, their customers must have told them the same thing. One prominent i-cut like program has been significantly modified every year since it was first developed.

- Initially the CNC manufacturer said all they needed was an inexpensive vision system that would handle position and rotation, so that their customers would no longer have to use mechanic blocks to ensure substrate location.
- Next, they added linear compensation capability, so they could independently stretch or contract in each of the X and Y axes, and account for print mis-registration. They were sure that nothing else was necessary.
- Finally, they were required to modify the product further to handle separate linear compensation for each specialty graphic image printed on a substrate, as they found that one correction for the entire board was not sufficient.
- Unfortunately, for them and for others, only i-cut can handle non-linear compensation on each graphical image on a printed piece, regardless of size or complexity.

To show how necessary this feature is, i-cut keeps track of the last 10 jobs it finished, and notes the largest non-linear and linear errors that it found on each job. The following table shows a number of different materials and printing processes, and print sizes. Note that in the majority of cases the non-linear error was larger than the linear one.

Over a number of years of running a trade shop and doing demos, i-cut has tabulated these errors and has seen that 9 out of 10 jobs show the larger non-linear error, Certainly, the jobs that we see are those that closely mirror what a typical customer might see,

Linear	Non Linear	Date
0.0051 in	0.0098 in	02/24/09 15:02:16
0.0071 in	0.0091 in	02/24/09 14:56:51
2.1172 in	0.0264 in	02/24/09 14:40:39
2.1170 in	0.0085 in	02/24/09 14:37:29
0.0304 in	0.0865 in	02/04/09 08:31:18
0.0296 in	0.0391 in	02/03/09 17:28:47
0.0280 in	0.0824 in	02/03/09 17:22:49
0.0304 in	0.0896 in	02/03/09 17:20:00
0.0069 in	0.0285 in	02/03/09 14:12:34
0.0096 in	0.0222 in	02/03/09 14:09:14

All Time Highest Distortion		
Linear:	2.1172 in	02/24/09 14:40:39
Non Linear:	0.0896 in	02/03/09 17:20:00

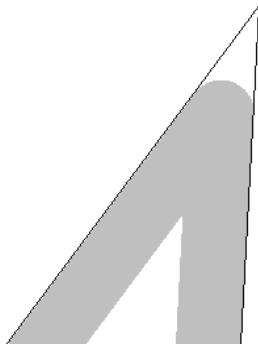
Save Excel File in:

Distortion log in i-cut application

although certain jobs, such as a full sheet of 4 inch circles might not require non-linear correction, but the – what will the next job a customer brings to you look like? Shouldn't you be sure you have the capability to do any job with fewer than 2% spoilage?

Ease of Use

i-cut is different from many other software products used to run CNC machines. When not finishing print, you are not encumbered in the variety of things that a CNC machine can do. The operator is generally the one who gets to use his or her ingenuity to ensure that this freedom of operation results in what the customer needs to be produced. With print, however, all that is necessary is to cut/finish an accurate cut line on a pre-defined printed substrate. The design has been done elsewhere, and the finisher is used as a production device, to translate a set of prints into finished product. For this task, rather than to give the operator all the tools necessary to do everything, the idea of i-cut is to minimize creativity and make it as easy as possible to manage this near line manufacturing process and achieve the least amount of scrap.



Milling path preview

i-cut is not a design program. Its customers get print jobs from everywhere, designed in many different programs, and the finisher is driven by many different RIP's. Simplicity increases efficiency and reduces mistakes.

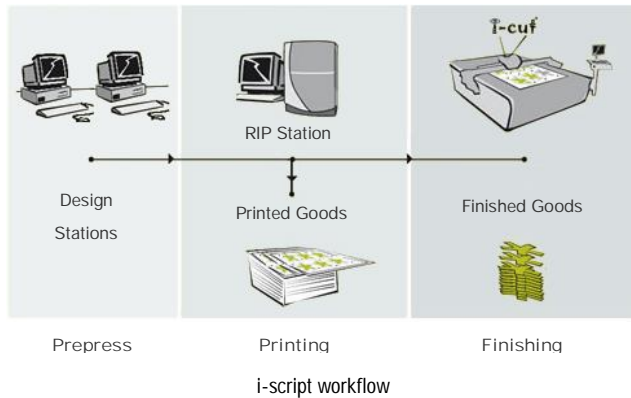
Unlike other programs, i-cut greys-out functionality that cannot be achieved on the specific cutting/finishing device being used, so that functions that cannot be achieved cannot be invoked. It also simplifies the routing process by showing a tool path preview to determine how well the router bit will cut outside or inside corners, allowing the operator to choose a different diameter bit if necessary, further eliminating wasted time and materials.

Special features within i-cut allow for capture of register and continued cutting of continuous die lines where materials are longer than the table.

In fact, i-cut efficiencies have led a number of OEM partners to choose using i-cut without vision capability as the front end to their systems, so that all users get its advantages and do not have to learn new tricks when they upgrade to an i-cut vision finishing capability.

Workflow and Plant Efficiency

As we have learned with most printing equipment, almost any press or digital printer will do the job. They are all reliable and all have many customers who would not buy from another vendor. Then, how does a prospective customer decide which equipment to purchase?



It has become clear the best company supplier is one that understands the customer's business. We at i-cut have come to learn that the way a specific piece of hardware interfaces with the entire workflow can have a large impact on the bottom line.

Over a dozen RIPS utilize i-cut's i-script™ language to output the cutting die-line file when the job is RIP'ed to the printer. This file

contains all the contour cutting information, including bar code, in many cases, thus tying the print job and the cutting files together and simplifying the transmittal of cutting instructions within traditional programs (illustrator to RIP to cutter) so that the finishing operator must only know how to run the machine, not how to fix, or otherwise modify or expand the files to capture accurate finishing.

The i-script capability has been extended to include automatic generation of optimal register marks, utilizing the same technology that i-cut uses for precision to determine where the marks should be placed to achieve the level of quality the customer demands. This removes the manual operation necessary by operators and/or graphics professionals and significantly boost throughput while optimizing quality. In those cases where a company can standardize on a single RIP, this really brings workflow benefits.

In the screen print world, the above software presents a really strong opportunity as multiple RIPS are generally in use. In addition, i-cut on its own gives the printer a unique advantage. By utilizing i-cut's intelligent register mark generator the printer also gives himself the opportunity to finish the job in many different ways depending upon how busy equipment is in the finishing department. If standard dies are available they can be used, or if not, any brand of cutter/finisher that might be installed, and is i-cut compatible can be used to efficiently finish the job. This ability to choose the manufacturing method based upon the factory availability goes a long way towards maximizing efficiency and lowering costs.

Conclusion

Why has i-cut earned the reputation as the premiere software solution for vision based registration in graphics finishing? It works, simply.

Only i-cut offers the power of proven full non-linear distortion correction, a simple, intuitive user interface, and full prepress and RIP integration so that jobs are quickly prepared and sent to the cutting device without error or miscalculation.

Operators with limited or no computer skills are able to produce precision-cut graphics after only a few hours of training. Owners and managers can rely on razor sharp reliability and efficiency - without spending time worrying about costly mistakes or missed deadlines.

Print runs from just one sheet to hundreds or even thousands are contour-cut in the most reliable, precise and economical manner. Setup times are minimal - or in many cases virtually eliminated - with the latest workflow integration software pioneered by i-cut, such as the revolutionary i-script® RIP-to-cut interface language, and the ai-cut® register mark insertion plug-in developed for Adobe Illustrator.

The result is the perfect solution for the CAM or CNC manufacturer requiring vision control for their products. With i-cut as your vision solution, your customers will produce fast, accurate and efficient graphics finishing.