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White Paper

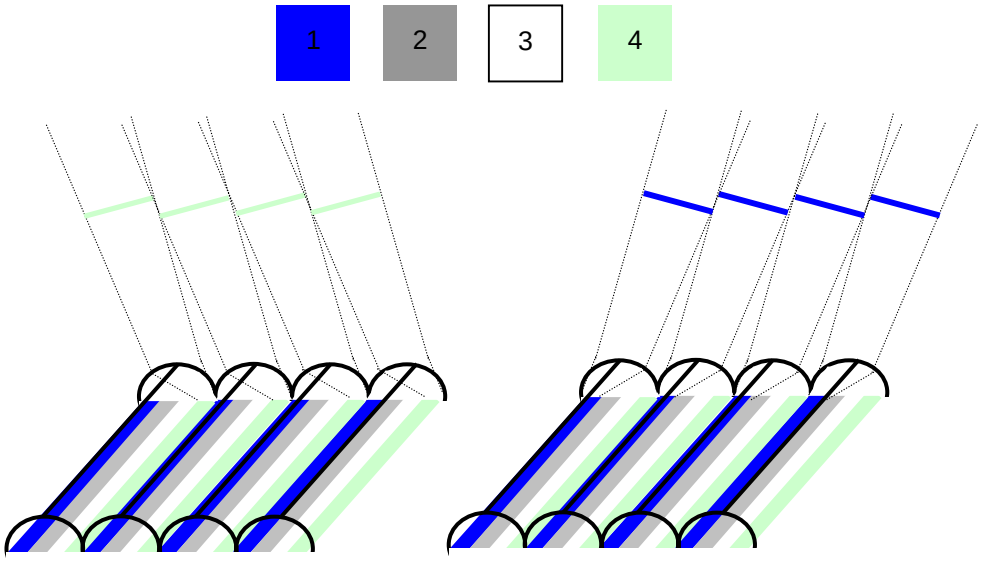
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How does lenticular printing work?

In a lenticular print job, the image that a viewer sees changes with the viewing angle. This property is used to achieve effects such as flips, morphs, animations, and three-dimensional (3D) images.

To create a lenticular piece, the designer selects images and a suitable lenticular (lens) material, and prepares the artwork to enhance the intended effect. The images are divided into strips, interlaced, and printed onto the back of a plastic lenticular sheet. The lenses must be aligned precisely with the interlaced image. The pitch of the lenticular material is measured and then used to determine the required image resolution.

When the image resolution is correctly matched to the pitch of the lenticular material, exactly one period of the interlaced images is printed under every lens (see figure below). At any given viewing angle, each lens focuses on a narrow strip, typically 10 to 20 microns wide, of the image printed beneath it. The overall visible image is composed of a set of narrow strips from the corresponding position under every lens, magnified in width by a factor of 20 to 30. At different viewing angles, the lenticular material focuses on and magnifies a different set of image strips.



Technical challenges

Lenticular effects are possible because the lenticular material selects and magnifies a portion of the interlaced images. Depending on the specific lens parameters, a narrow strip of 10 to 20 microns is magnified by a factor of 20 to 30. As a result of this magnification, sub-pixel shifts and effects that are not noticeable in non-lenticular printing may form visible structures in the image. This is one reason that a screen that is optimal in one workflow may not work well in another—the lenticular material may magnify subtle differences in the screening algorithm.

Ghosting is a common, unwanted artifact in lenticular work. Ghosting occurs when a portion of one image intrudes on the adjacent interlaced image strip. This causes the simultaneous appearance of multiple images at one viewing angle. Sources of ghosting may include:

- Lens focal area that is wider than a single image strip
- Mismatch between actual lens pitch and image resolution, leading to aliasing
- Misregistration between separations
- Angular misalignment of the image strips relative to the lenticular material
- Sub-pixel signatures inherent in all electronic and mechanical systems
- Dot gain and dot growth
- Variability in the pitch of lenticular material: for example, across the sheet, throughout a batch, or due to spreading on press
- Spiral imaging and other geometric corrections in plate making

Spiral and other geometric corrections

Spiral and other geometric corrections are used in plate-making to square the image. In lenticular work, the correction for spiral imaging will be visible under the lens if pixels are shifted between image strips or across lens boundaries. Therefore, lenticular plates are made with the interlaced image strips oriented along the drum. To avoid pixel shifting across image strips, plates should also be imaged on registration pins with little rotation, or imaged with rotation correction turned off.

Aliasing

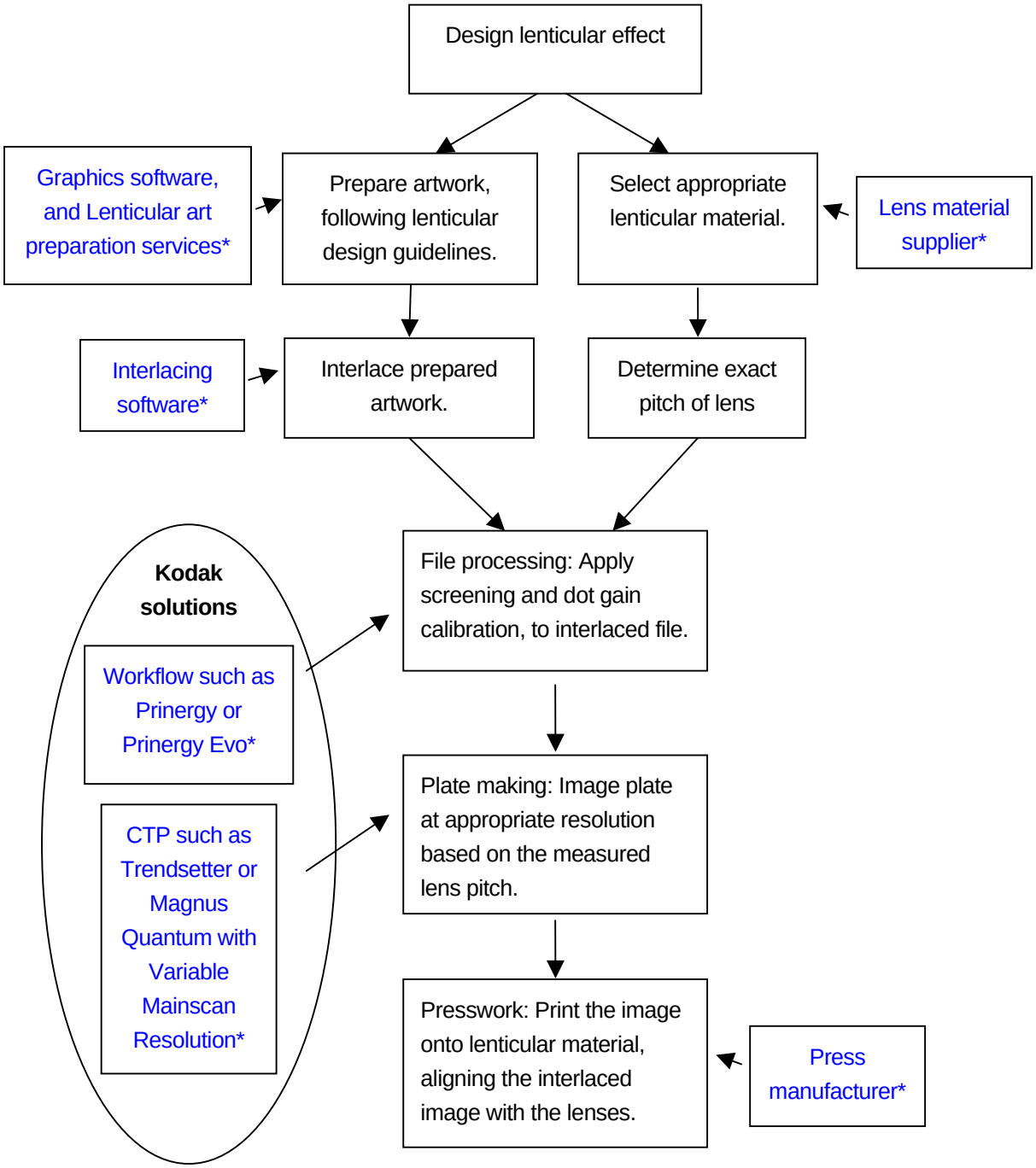
Kodak® offers products that can be used to address some of the challenges of lenticular printing. Variable resolution allows the printer to measure the pitch of each batch of lenses and output a plate with the correct resolution required for that lens, thus eliminating sub-pixel aliasing introduced by scaling. This option is available as Variable Resolution on the Kodak Magnus™ 400 platesetter, and Variable Mainscan Resolution (VMR) on the Kodak Trendsetter® and Magnus Quantum platesetters.

Misregistration

Kodak imaging devices are effective at reducing misregistration between separations. The Kodak SQUARESpot® thermal imaging technology uses focus and temperature compensation to produce consistently imaged plates. VMR or web growth options can help to compensate when lens spreading causes misregistration on press. If you are unfamiliar with solving the complications of on-press registration using VMR, Kodak recommends that you work with the lens manufacturer or a lenticular consultant.

Lenticular workflow

The complex process of lenticular printing can include Kodak's device and VMR options as part of the solution. The following flowchart summarizes the steps in lenticular printing, and vendors* involved in each step.



Resources

Because Kodak is not a full lenticular solution provider, Kodak is unable to provide consultation or advice on an end-to-end lenticular workflow. If you are unfamiliar with lenticular printing, Kodak recommends that you work with a third-party consultant who specializes in all areas of lenticular printing, as well as your lenticular material supplier and your press manufacturer.

One such lenticular consultant is Leap Technologies, LLC, who covers topics such as:

Lenticular material quality control

- Pitch consistency
- Establishing an average pitch target

Output device

- Setting up and using standard pitch calibration charts for proofers and platesetters

File preparation

- Creating a protocol for selecting the proper lenticular material for desired visual effect and product
- Calibrating interlacing software and establishing parallax limits
- Establishing pitch for curved products, such as cups, containers and packages
- Guidelines for robust file preparation relative to output dependencies

Prepress workflow

- Establishing lenticular specific halftone screening that is calibrated to specific lenticular material designs (100 lpi, 75 lpi, 60 lpi, and so on)
- Imposing images to be in synchronize phase with, and aligned with, the lenticular material
- Creating lenticular-specific press marks for maintaining proper color registration, printing squareness, sheet distortion, and pitch control.
- VMR adjustment

Press

- Lenticular-specific color-to-color registration requirements
- Length of print adjustment for individual colors through VMR to compensate for sheet growth in the press
- Ink density, including density standards, ink optimization, and consultation with ink vendors
- Material distortion control and press adjustments

Contact: Leap Technologies, LLC 608.606.2210 info@leaptechnologies.net

About Kodak Graphic Communications Group (GCG)

The leading provider of graphic communications solutions worldwide, Kodak's Graphic Communications Group (GCG) offers image capture systems; professional color, copydot, and high-speed document scanning systems; inkjet printing and proofing systems; workflow and color management software; thermal imaging devices for film, plates, and proofs; high-quality proofing media, printing plates, and recording film; on-demand color and black-and-white printing systems; data storage products; and professional services. With corporate headquarters located in Rochester, N.Y., Kodak (NYSE: EK) has the largest global sales force and is committed to a digitally oriented growth strategy. For more information, visit www.graphics.kodak.com.

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