Supplementary material

S.1. *Cyclostéréoscope*

We tried to use back projection in the initial test with the first constructed cylindrical *cyclostéréoscope* prototype. However, it turns out that back projection does not work, and the stereoscopic effect breaks down. This is because, in the back of the projection screen, the barrier does not rotate with the direction of the interleaved image stripes projected through the barrier from the front but in opposite directions. Another notable effect, essential for glasses-free stereo to work, is that even though the barrier rotates in front of the screen, the viewing zone pattern stays fixed in space and does not move.

S.2. Art Installation

Figure S1: Impressions from the art installation showing the final conical version of the *cyclostéréoscope* and the projection of the analog 35mm short film.

S.3. Analog 35mm Stereo Short Film

The analog stereo film projected onto the *cyclostéréoscope* shows a greenhouse amid a field and the camera moving slowly toward it. Coming closer and closer, the camera eventually enters the greenhouse. In the far back, we see two projectors opposite the *cyclostéréoscope*. The camera moves towards it while the sun begins to go down. In the dark, the camera approaches the projection on the *cyclostéréoscope* and starts to move in, past the rotating parallax barrier and into the projected image. The sound of the projectors and the rotating *cyclostéréoscope* is audible. As the camera continues to move in, the projected image becomes more granular, and as time slows down, the sound frequencies lower, and the projection starts to flicker, exposing the refresh rate and film transport phase of the projectors. Eventually, the individual dye clouds and individual layers of the film substrate become visible. The camera moves through the layers until, in the middle, time comes to a brief halt before continuing in real-time as the camera moves out again on the other side, revealing the beginning shot of the film sequence and closing the loop. A few selected frames of the short film are shown in Figure S5.

Figure S2: Images of the custom-made analog camera stereo rig.

S.3.0.1. Analog Stereo Rig To record a film in stereo, two synchronized cameras are necessary to record the scene from slightly different viewpoints. To this end, we built an analog stereo camera rig, shown in Figure S2 which used a custom electric drive system to synchronize two 16mm Bolex cameras, which usually would need to be operated manually. An Arduino Microcontroller controlled two stepper motors with closed-loop drivers. The custom software processed the input from various switches to ramp up the motors to 24 Hz during recording and change the motor speed and direction. The uses a half-transparent mirror, with one camera recording through the mirror and the other camera recording through the reflection, enabling a very small stereo offset between the two cameras. This rig was used to record the second half of the 10-minute analog stereo short film shown in Figure S5.

Analog color film generally consists of multiple layers of photosensitive substrate, which are designed to capture light of a specific range of wavelengths, usually corresponding to red, green, and blue light. The image is recorded by exposing and focusing light through camera optics onto the film layers, which include photosensitive silver halide crystals. After the film is exposed to light, a chemical development process is used to convert the exposed parts of these crystals to form silver grains proportional to the amount of light they received. In a subsequent chemical development process, small dye clouds of complementary colors (cyan, magenta, and yellow) are formed inside the different film layers. The density of these colored dye clouds depends on the amount of light exposed onto the film layers during recording. These layers of varying density form the (negative) color image via subtractive CMY color mixing. For projection, a positive film is used, in which bright parts of the image appear bright, in contrast to a negative film.

Analog projectors cast light through the film positive and subsequent optics onto a screen. The film frames are transported in front of the light beam at a rate of 24 Hz. In addition, a rotating shutter blade blocks the light at a higher rate, usually 48 Hz, i.e., displaying each frame twice with dark phases in between.

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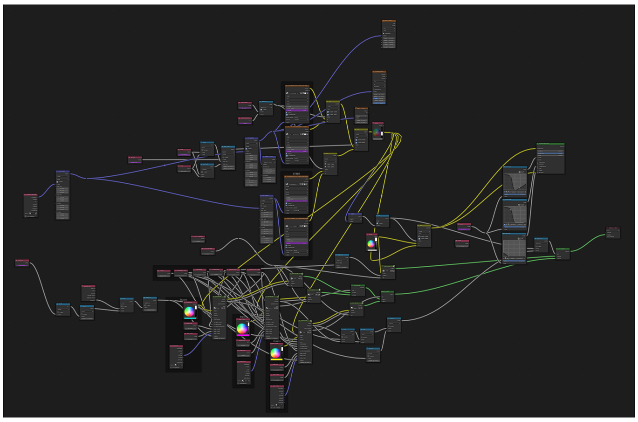

Figure S3: Node graph of the material shader.

S.3.0.2. Dye-cloud material rendering Actual analog film is made out of more than three layers [EK07, KKM*00, Rog07], e.g., multiple layers of different sensitivity per wavelength range (RGB), different filters, separation layers, coatings, etc.; however, for practical reasons, we chose to model only the base substrate and a single layer for each dye-cloud color (CMY), i.e., cyan, magenta, and yellow.

We experimented with creating the film's dye clouds using procedural geometry in early tests. However, it quickly became apparent that the generation and memory overhead for the vast amount of necessary geometry would become too large, and rendering a complete three-minute animation sequence would take too much time. We, therefore, switched to using volume rendering and a custom material shader. A coarse overview of its node graph is shown in Figure S3. Our approach is conceptually similar to half-toning [Kan99]. We use random patterns, only CMY colors and no black (as commonly used on half-toning for color prints), and work in a volume where the "half-toning" effect is only visible along one axis.

S.3.0.3. Stereo Rendering Since the analog short film is stereo, the animated sequence must also be rendered in stereo. At the beginning of the sequence, we used the two stereo frames as input to the volumetric film material, each rendered for the corresponding virtual stereo cameras. However, to provide a consistent stereo effect close to or inside the film's dye clouds, we needed to transition to using only one of the stereo frames as input (RGB_l, see Equation 1; and Figure S4) to the film material shader. Otherwise, the dye clouds would differ in both virtual stereo views, and the 3D effect would break down. Therefore, we placed the transition from using both stereo images to only one around the point in the animation sequence where the dye clouds become visible and the original image is no longer recognizable.

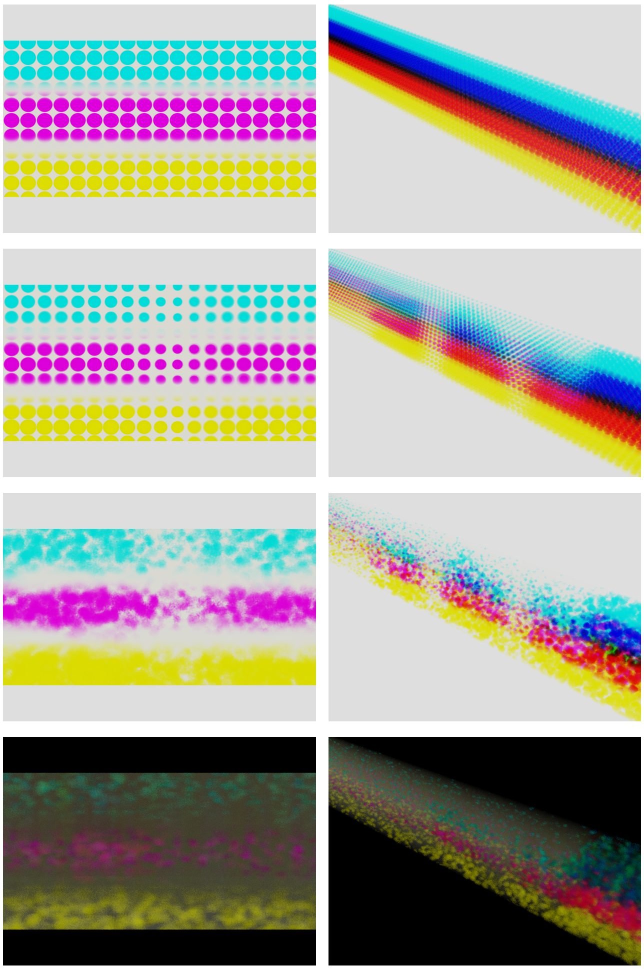

Figure S4: Illustration of the volumetric material shader using a thin slice of the film volume. The left column shows an isometric view parallel to the layers of the film slice (see corresponding red rectangle in Figure 10), and the right column shows a perspective side view above the film's surface. To create randomly distributed dye clouds, we modulate the density and color of the volume. We create regularly spaced spheres for each colored layer from a regular Voronoi cell pattern (first row) and then use the RGB color of the input image to modulate the size of the spheres (second row). Lastly, we modulate the Voronoi cell positions and sphere outline with random noise to create a more natural cloud-like appearance (third row). The first three rows show the volume under diffuse background illumination for illustrative purposes, and the last row shows it illuminated by a single spotlight, as used in the film sequence.

Figure S5: Sequence of selected frames from the 35mm analog stereo short movie, starting top left and ending bottom right.

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