NPR Lenses: Local Effect Control for Non-Photorealistic Line Drawings

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Modern line rendering systems can create high-quality illustrations. However, the interaction possible with such systems is often limited to selecting an appropriate viewpoint and applying certain line styles to the entire model. NPR Lenses are a new non-photorealistic rendering tool, that allows integrated distortions in 3D with common 2D interaction techniques. NPR Lenses support local adjustments to rendered 3D line-drawings while being view-aligned and still supporting the independent adjustment of the 3D scene.

1 Approach

NPR Lenses integrate 2D interactive lens controls with regular 3D NPR rendering to provide a variety of distortion effects using familiar 2D interaction metaphors. They apply NPR effects to line drawings generated during a fully-automatic rendering process. An NPR Lens resembles a hand-held magnifying glass in the physical world. It is scene-independent, placed between the scene and the viewpoint, and influences the entire part of the scene that is projected into its influence range on the viewplane. Fig. 1 shows an NPR Lens integrated in a perspective and orthogonal view frustum.

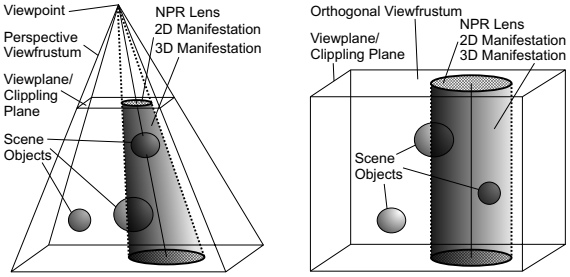

Figure 1: Schematic view of NPR lenses in two view frusta.

2 Locally Controlled Lens Effects

An NPR lens has several attributes to change the application of effects on lines in 3D: a center, a region of maximum effect, a degree of effect, a region of influence, and an attenuation style. Depending on these factors a lens can integrate effects seamlessly or create abrupt changes. We currently offer the following types of lenses: Line-Style Lenses, Hidden-Line Lenses, Spatial-Distortion Lenses, object-based constraints, and combinations of all of these lenses. Our approach is open to the development of further lens effects.

Line-Style Lenses allow local influence of line styles such as line width, saturation, transparency, or color. This local influence of line style is often used by artists to create emphasis in certain parts of a drawing to guide a viewers attention. Fig. 2(a) shows how three lenses (red, orange, green) influence the color of the flower. The color lenses smoothly integrate color changes across the lines.

The Hidden-Lines Lens displays silhouette or feature lines that are invisible from the current view on a model. The lines are displayed with a dashed style in the influence range of the lens. Fig. 2(b) shows how such a lens can show invisible parts of the hinge at two different locations. The shown lens also influences the color of the lines to attract the viewer's attention. By combining two or more lens types, it is possible to create more comprehensive and expressive renditions of a 3D scene without having to manipulate the 3D objects directly. In Fig. 2(c) the first two types of lenses have been combined with an object-based constraint on the ureter of the kidney. The lens shows the invisible parts of the ureter in a dashed and colored style and increases line thickness along its central part.

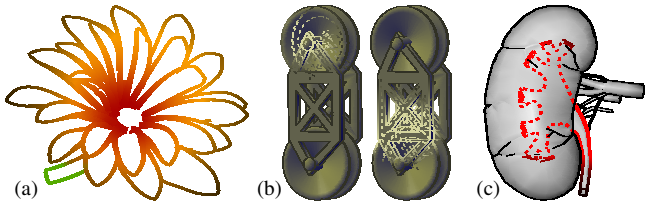

Figure 2: Line-Style Lens (a), Hidden-Line Lens (b), and a combination of these two lenses with object constraints (c).

Similar to fisheye lenses, the Spatial-Distortion Lens creates geometrical distortions of lines. Artists often use this method to place importance on features in a drawing, e. g., to create comic-like effects. Fig. 3 shows effects imitating distance-changes (a), creating a comic-like appearance (b), and an artistic appearance (c).

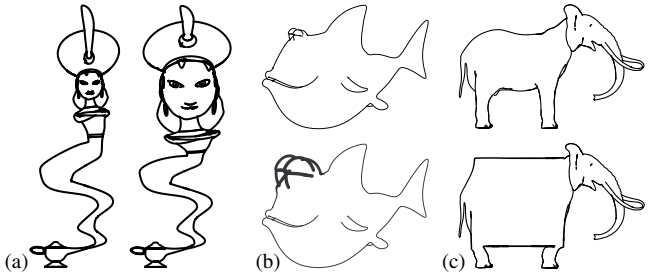

Figure 3: Spatial Distortion Lens applied to three models.

Our work uses the OpenNPAR line rendering system [Halper et al. 2003; Isenberg and Brennecke 2005] and parameterizable lenses [Carpendale and Montagnese 2001]. We apply these lenses to line rendering by modifying the typical line rendering pipeline.

3 Conclusion

NPR Lenses are highly flexible. They allow the manipulation of line styles and paths independent of the object structure. Both the 3D viewport and the lens parameters can be independently adjusted to create the desired renderings. By combining several effects in one lens, it is also possible to apply several different lenses at different positions. These techniques can be used in many application domains including comic generation, cell animation, as well as static and interactive illustration.

References

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