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The starry night texture and its use to isolate depth cues

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Abstract

The Starry Night Texture (SNT) is a new surface texture that renders painted objects invisible against a similarly painted background, in static monocular views. Object shape and location become visible when motion parallax or stereo cues are provided. SNT consists of a great many high luminosity spots, each tiny in size, distributed randomly (using the uniform distribution) on an otherwise dark surface. The spots are indistinguishable from point sources when imaged, yielding a Starry Night Image (SNI). A single number (the “densintensity”) characterizes the expected number of spots of criterion luminance or brighter, per unit area. To achieve invariance of the image statistics across changes in surface distance, the luminance of the spots is distributed as the square of reciprocal luminance. To achieve invariance across slants, spots are flat on the surface. The resulting Starry Night Image (SNI) is itself an SNT.

In its pure form, SNT contains occasional “supernovas” (very intense stars) and infinitely many dim stars. To use the texture, we therefore adopt upper and lower limits on spot luminances. We justify this by evaluating the probability of encountering SNIs that are missing very bright stars, and we show that the dim star cut-off gives little distance information. We present a rendering method and consider tradeoffs given the dynamic range of the display.

SNT may be of experimental value. Other texture patterns reveal 3D scene structure under reasonable assumptions, whereas SNT reveals no structure. Also, back projection of uniform density random dots onto a scene results in apparently nonuniform dot distributions on surfaces, once scene structure is revealed by stereo or motion. This did not occur with back-projected SNI, suggesting that the perceptual mechanisms used to infer surface patterns on slanted surfaces, and pattern scale at different distances, expected no change of local image statistics from changes in surface slant or distance.

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