Stylizing Metals and More with the Glint Filter

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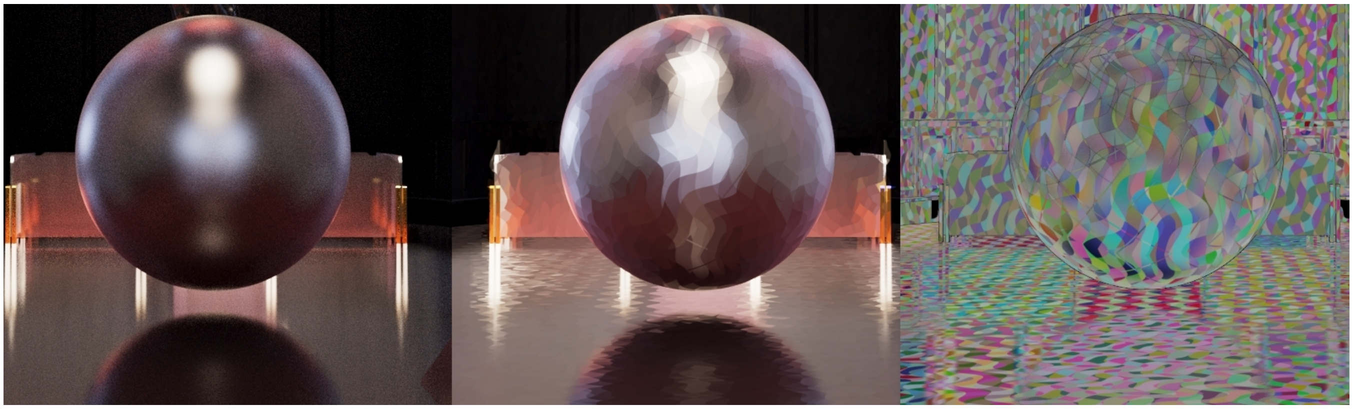

Figure 1: Original beauty render (left). Result after the Glint Filter (middle). Glint ids used to generate filtered image (right).

ABSTRACT

We present a novel and artist-controllable system for stylizing metallic surfaces. This technique filters a beauty render with a Cryptomatte-encoded identifiers pass to generate a new stylized image. The ids pass drives an image-space color flood fill algorithm that uniformly colors regions to create a faceted metal appearance. The ids are generated using a variety of methods that target different aspects of the reflective surfaces. Tools that further modulate the facet ids give artists control over the effect in both render and compositing. The result is a smooth and temporally coherent effect that complements other non-photorealistic imagery. We can expand and generalize this technique to apply to non-faceted metallic surfaces.

CCS CONCEPTS

• **Computing methodologies → Non-photorealistic rendering**; **Image processing**.

KEYWORDS

rendering, compositing, non-photorealistic, Cryptomatte, image processing

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1 MOTIVATION

Typical 2D illustrations of metal involve painting flat, simple shapes that provide the impression of the surrounding environment but without the distraction of small details. These shapes are generally depicted with uniform colors or simple gradients and are arranged in a way that imply the underlying surface topology. As the surface moves or deforms, the reflected shapes evolve in such a way that they flow naturally with the object or with the image's composition. This maintains the appearance of a reflective material under a simplified, artistic representation. However, transferring these qualities from 2D into a stylized 3D animated feature has proven challenging.

2 GLINTING METALS

In order to produce the uniformly shaded regions (referred to as glint facets) in the desired style, we developed a compositing tool called the Glint Filter. The tool uses an image-space color flood-fill algorithm that takes two inputs: a source image of the metal from a physically-based render, and a labeled ids pass. Each unique id in the ids pass defines a glint facet that the filter will flood-fill with a representative color sampled from the source image. The representative color can be generated either by sampling the image-space centroid or by taking a weighted average across the facet region.

In order to maintain high-quality representations of the glint facets, we chose to use the Cryptomatte file format to encode the ids pass. This allows support for clean, anti-aliased boundaries and transparency. In order to extend support for arbitrary id data, we

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created a sample filter we called Cryptopaint. Cryptopaint hashes samples from any color arbitrary output variable (AOV) to a float identifier, and accumulates the sample weights per id during the course of the render. The color hash is optionally concatenated with the native Cryptomatte id from the render to prevent id conflicts. By abstracting the id source to a color AOV, artists can drive the Glint Filter with any user data signal.

3 GENERATING GLINT IDS

The most straightforward way to create glint ids is to paint them into a map and apply it directly onto the surface of an object. This is well-suited for metallic objects with ornate designs. The design elements are enhanced when each facet is shaded uniformly through the Glint Filter. To streamline this process for artists, we provided a tool that converts the albedo texture map to a map with non-repeating color ids. This tool uses OpenCV to separate and uniquely color non-connected components in the albedo. It is important to ensure that glint ids are not interpolated until after they are processed by the Cryptopaint sample filter. Any upstream modifications to the id colors results in a corrupted hash.

It is also possible to generate ids from the contribution of a target light. This creates ids that preserve the delineation between light and shadow (the shadow line) even after the filtering process. This is desirable when the artist wants to preserve the shading or shadow line produced by a light, usually the key light. Without these light-driven ids, the shadow line is often broken up by the orientation of the other glint facets. It is worth noting that the breakup may be desirable depending on the chosen art style.

The first two techniques described are insufficient to simplify the environment's contributions to the reflections. To integrate environmental reflections, we created an environment map of glint ids composed of simple geometric shapes in the desired style. Using the reflected view direction it is possible to do a lookup into this map to find the glint ids. The resulting ids are the natural reflection of the simplified shapes onto the object's surface. As the view changes or the object deforms, the reflected shapes remain simple but behave analogously to real reflections. After these ids are run through the Glint Filter, the object remains visually grounded because the resulting simplified reflections preserve the colors of the actual environment.

The reflected glint ids technique can be extended by using AOVs generated by the light path expression (LPE) system. By modifying the albedo LPE with additional scattering events, the glint ids can be captured on multi-bounce reflections, refractions, or transmissions. For example here is an LPE to capture the secondary bounce glint ids:

$$
\begin{aligned}
lpe : nothruput; noinfinitecheck; noclamp; unoccluded;\\
overwrite; C < RS >< .S > *(O'idsMap')
\end{aligned}
$$

This technique achieves a stylized look that also respects the properties of the original material, such as albedo and roughness, as well as the underlying geometry. This means that the Glint Filter is not limited to creating highlights or representing chrome metals, but can naturally stylize a wide range of materials.

4 FURTHER MODIFICATIONS

Each of the described methods for generating ids target specific metal properties, but are insufficient to capture the full range of metal behavior. By layering the different glint ids, we produce a pleasing, production-quality representation. To facilitate that and allow further control of the glint ids, a suite of tools was created to modify the underlying Cryptomatte data. The tools can combine different id passes using multiple merge and overlay operators. Additional functionality was added to selectively blur the Cryptomatte data itself (softening edges and contributions), add breakup in the falloff edges, and automatically group ids using other data passes. We also found it useful to provide a way to convert an RGB matte to Cryptomatte data. These Cryptomatte utilities formed a robust toolkit with which lighting and composition artists built complicated effects. They also allowed lighting artists to make changes to these stylized materials without modifying the existing assets or rerendering.

5 CHALLENGES

In certain scenarios, the Glint Filter introduces flickering from frame to frame. This is particularly prevalent when the filter processes hotspots from sharp specular lobes and is exacerbated by HDR values. This also occurs when centroid sampling of a glint facet amplifies sample noise. A downstream temporal filter was added to alleviate this. This additional filter uses a weighted kernel function across neighboring frames on colors of the glint facets. The result is a smoother transition within each facet from one color to the next. This also functions as an additional artistic control: using a luminosity-weighted temporal blend, an artist can make highlights linger in shadow or reduce undesirably bright facets.

During production, materials artists would find it frustrating that the final look and feel of the asset depended so heavily on a compositing workflow, as they could not fully evaluate their work until final lighting. To mitigate this, a strong partnership between the departments was necessary. The artists developed composition and rendering templates that standardized and streamlined the setup across multiple shots and assets.

6 CONCLUSION

Our artists were able to use the Glint Filter to hit a unique stylized look that met the quality requirements for feature film animation. The results felt believable and grounded under any kind of lighting scenario. Furthermore, the workflow was achievable on a production schedule. The general nature of the filter and its supplemental tools allowed for adoption into a variety of other domains. The filter was integrated into the composition workflow for all characters to achieve graphic indirect lighting. It was also used to remove detail and abstract forms in the far background. By advecting ids through a volumetric simulation, artists were also able to stylize fire and smoke. The Glint Filter has a wide variety of applications for stylizations that make it useful across both animated film and special effects.

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