Wig Refitting in Pixar's *Inside Out 2*

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In Pixar's feature animation *Inside Out 2* (2024), emotion characters are identified with their corresponding human characters by exhibiting similar wigs. To achieve this look, we developed a custom rig that assists the sharing and reuse of hair grooms between characters of different shapes, feature proportions, and mesh connectivities. Our approach starts by adopting curvenets as a light-weighted representation of scalp surfaces that eases the registration from human to emotion models by detaching the groom setup from the underlying mesh discretization. We then implemented a mix of surface-based and volumetric deformations that warp hair shells and guide curves onto the new character's scalp defined by the refit curvenet. At last, we incorporated a shaping tool for editing the wig layout controlled by additional curvenets that profile each hair shell.

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1 BACKGROUND

In the *Inside Out* franchise, emotions are portrayed by characters with wigs mimicking their respective human styles. Back in the first feature released in 2015, these emotion grooms were adapted from the original human wigs through an in-house Maya plugin that required the user to place an ordered list of landmarks defining correspondences between the source and target scalp surfaces. With these correspondences, a cross-parametrization was computed to align both scalp meshes into a common UV space and, subsequently, every hair curve was warped rigidly following the point-wise rotation defined by the scalp normals at the corresponding root locations. This technique produced a rough approximation of the wig refit which could then be refined using typical Maya tools such as lattice deformers.

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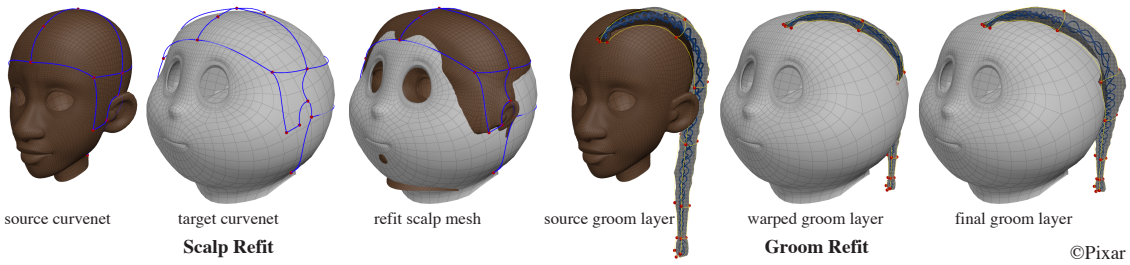

Since then, the grooming pipeline at Pixar has been re-engineered into a core component of the Presto animation system [Butts et al. 2018]. In this Presto-centric workflow, hair grooms are composed by layers of guide curves rooted at the scalp surface, accompanied with density textures and auto-generated shell proxies. Full-fidelity render hairs are then generated procedurally by processing the groom layers through a series of non-destructive shaping operators. Importantly, by leveraging the Presto execution framework, hair grooms are structured similar to a deformation rig, while also sharing direct access to the underlying character articulation. Building upon these Presto capabilities, we revisited the task of wig refitting and devised a new rig that enables transferring hair grooms across multiple characters with minimal user input. We deployed our tool in Pixar's animation *Inside Out 2*, refitting diverse styles of wigs from various human models to multiple emotion characters, in a total of 45 assets (see examples in the teaser figure).

2 OUR APPROACH

In this section, we describe the main steps of our technique for wig refitting. The inputs to our method include a wigged human character defining our source model from which the wig will be transferred, and the scalp mesh for the target emotion character that will receive the refitted wig. The output is a deformed copy of the source wig fit to each target emotion character. The figure at the top of the page illustrates a breakdown of our approach.

Scalp Refit. We start by refitting the scalp mesh from the source human to each target emotion character. To this end, we make use of curvenets as a rigging primitive that outlines the scalp surface of the source human model abstracted from its mesh discretization. As introduced by de Goes et al. [2022], curvenets are formed by 3D parametric curves with shared knots that generate surface deformations through a custom deformer known as the *Profile Mover*. For each emotion character, the groom artist sculpts the knots of the source curvenet towards the target scalp and then the Profile Mover deforms the source scalp mesh conforming to the target shape. Since curvenets are sparse and associated solely with the source model, switching the target character requires just posing a few knots (e.g., 10 knots in the image above), thus bypassing the need for order-sensitive landmark authoring and UV cross-parametrizations.

Groom Refit. After the source scalp mesh matches the target shape, we proceed by refitting the hair guide curves and the surrounding shell proxies that encode each groom layer. In a pre-computation pass, we bind the points forming each hair guide curve onto the source shell mesh using generalized barycentric coordinates. At runtime, we refit the shell mesh by first warping its points rooted at the source scalp towards the refitted scalp, followed by an iterative solver that minimizes the distortion of the shell surface constrained by the warped root points. Finally, we reconstruct the hair guide curves relative to the deformed shell mesh using the pre-computed generalized barycentric coordinates.

Hair Shaping. To incorporate character-specific edits, we implemented a shaping tool for fine-tuning the groom layers per target emotion character. Back in the source wig, we author additional curvenet primitives profiling the shell proxy for each groom layer, which are then carried by our rig to the target model following the refit shell mesh. Borrowing the technique presented by Nguyen et al. [2023], we refine the shape of the refit shell mesh based on curvenet adjustments defined by surface-relative direct manipulators. At last, we reuse the pre-computed generalized barycentric coordinates in order to update the hair guide curves complying to the shell mesh shaped by the curvenets.

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