Modeling Vellus Facial Hair from Asperity Scattering Silhouettes

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Table 1: Geometric parameters for vellus hair library

parameter		value(s)
hair density, hairs per cm^2	ρ	25, 50, 75, 100
avg. hair length, mm	l_μ	0.05, 0.125, 0.2
std. dev. hair length, prct. of mean	l_σ	10.0, 23.5, 35.15, 50.0
avg. hair orientation	θ_μ	$-\frac{3\pi}{8}, -\frac{\pi}{4}, -\frac{\pi}{8}, 0, \frac{\pi}{8}, \frac{\pi}{4}, \frac{3\pi}{8}$
std. dev. hair orientation	θ_σ	$\frac{\pi}{32}, \frac{5\pi}{64}, \frac{\pi}{8}$
avg. change in hair orientation	$\Delta\theta_\mu$	$0, \frac{\pi}{8}$
std. dev. change in hair orientation	$\Delta\theta_\sigma$	$\frac{\pi}{16}$
hair thickness, mm	t	0.015
underlying surface curvature, cm^{-1}	κ	0.05, 0.2, 0.5, 0.8

Table 2: Rendering parameters for the alHair shader

parameter	value
melanin	0.001
highlight width (β_R)	2
highlight shift (α_R)	3
opacity	0.05
diffuse lobe strength	0
specular 1 lobe strength (R)	1
specular 1 width scale	0.2
specular 2 lobe strength (TRT)	1
specular 2 glint strength	10
transmission lobe strength (T)	1
index of refraction (η)	1.55

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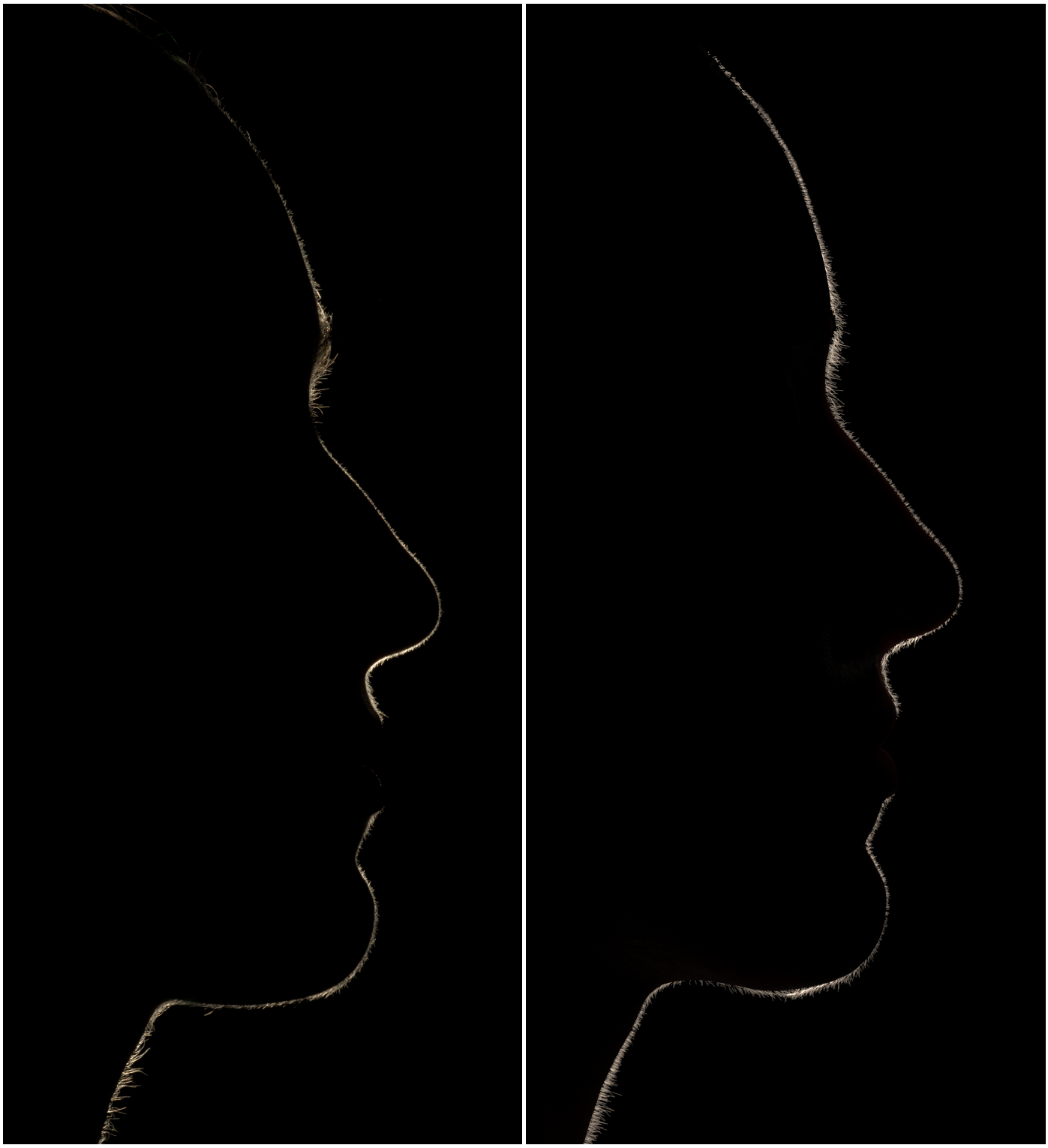
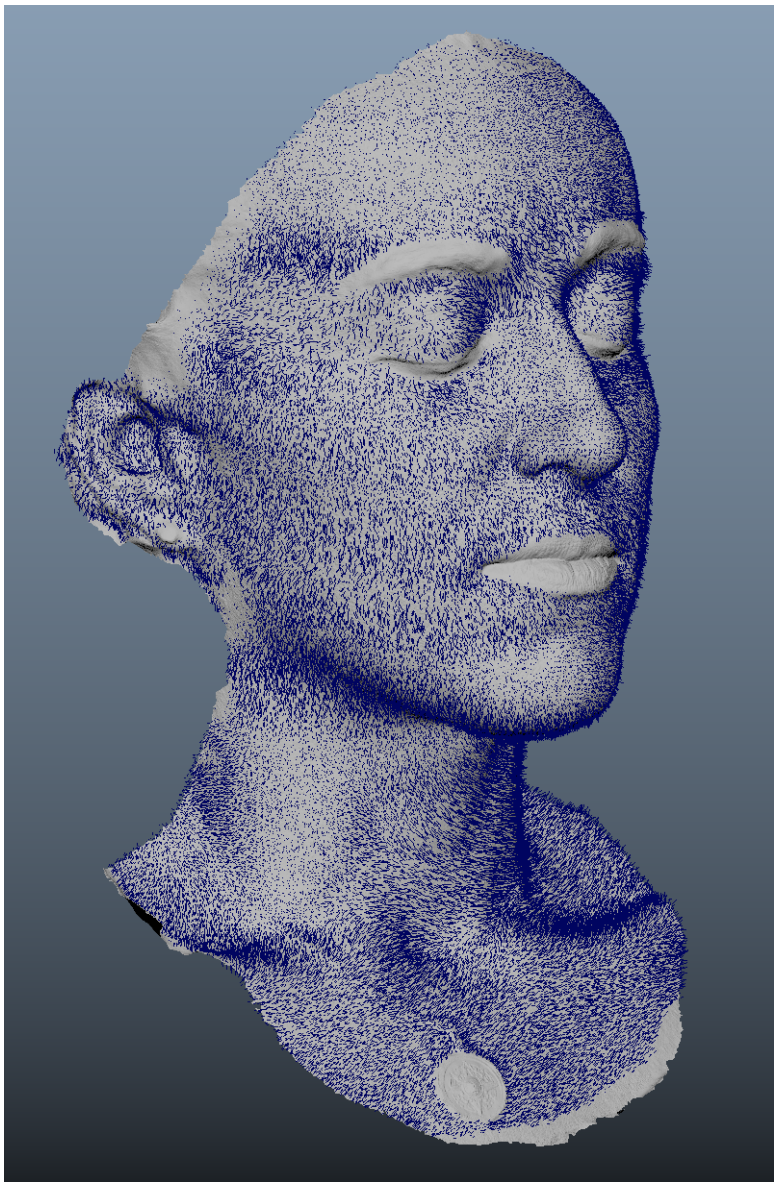


Real photograph Rendering with vellus hair

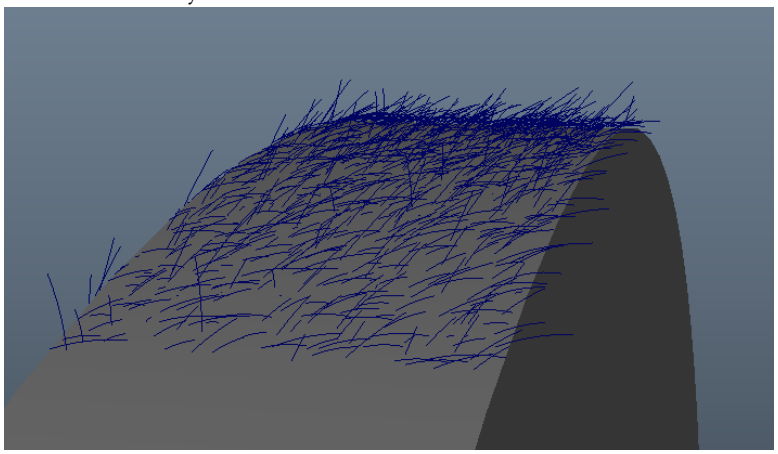
Figure 1: Comparison of crops of reference photograph (left) and backlit 3D model rendered with vellus hair.

Real photograph Rendering with vellus hair

Figure 2: Comparison of crops of reference photograph (left) and backlit 3D model rendered with vellus hair.



Maya Scene file of facial model with vellus hair.



Maya Scene file of cylinder of $\kappa = 0.05$, covered with procedurally generated vellus hair using geometry parameters.

Figure 3: Maya Scene files of vellus hair.

Real photograph Rendering with vellus hair

Figure 4: Comparison of front-lit reference photograph (left) and front lit 3D model rendered with vellus hair.

Real photograph Rendering with vellus hair

Real photograph Rendering with vellus hair

Figure 5: Comparison of details of reference photograph (left) and front lit 3D model rendered with vellus hair.

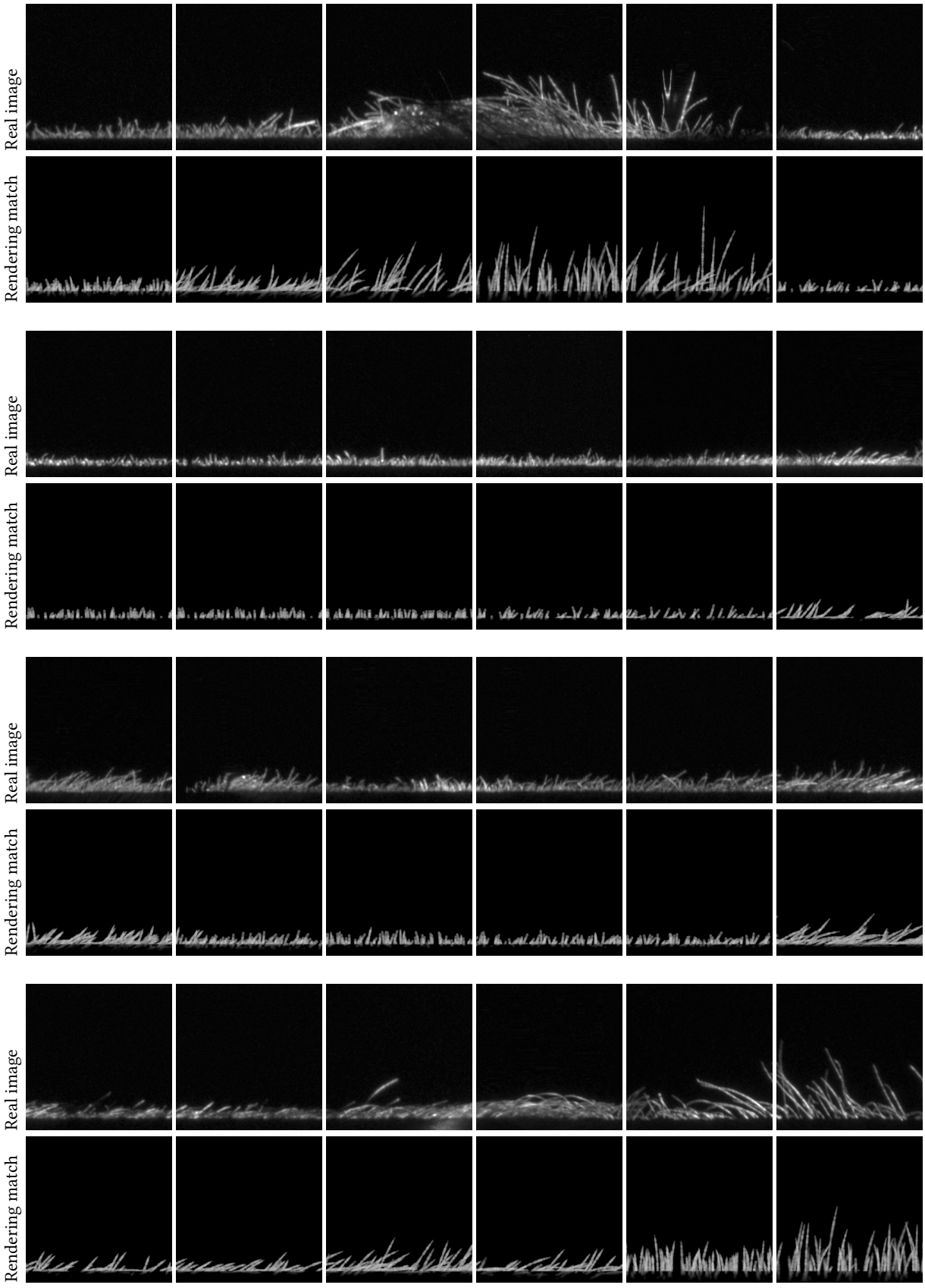


Figure 6: Upper rows (1, 3, 5, 7): Photographed backlit vellus hairs along a subject's silhouette, straightened by resampling. Lower rows (2, 4, 6, 8): Corresponding matching vellus hairs images from our rendered library, with matches computed using image statistics.

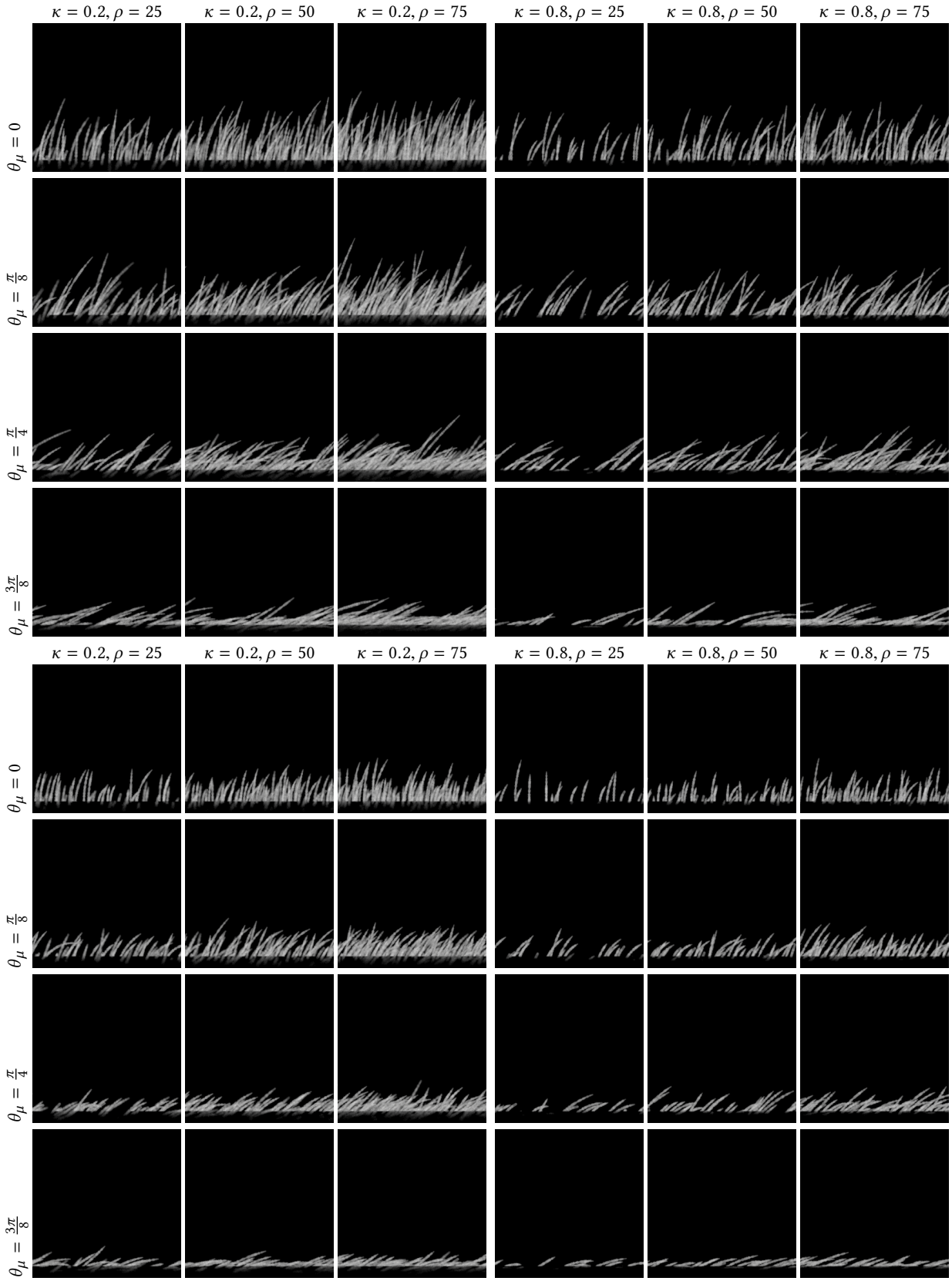


Figure 7: Examples of backlit vellus hairs from our rendered library. Rows 1-4: Varying average hair inclination from surface normal (θ_μ), underlying geometry radius of curvature (κ) in units cm^{-1}, and density (ρ) in units hairs per cm^2, for hairs of average length 0.2 cm. Rows 5-8: varying the same parameters for hairs of average length 0.125 cm. Other parameters do not vary. Images represent 1 cm of underlying geometry, along the image width. Curvature of the underlying geometry (κ) has a large impact on the visual appearance of hair density.