

Supplemental

S1. Modalities for Experimental Setup

In the following section, we present further details for our experimental setup to generate the real-capture dataset and measure reference friction values.

S1.1. Details of Cloth Material

The details of cloth materials used in our experimental setup for capturing real test data are presented in Table S1. All materials, except silk, match the description of materials used and characterized by Wang et al [32].

Mat. ID	Density	Composition	Correspondence in [32]
M1	0.187	Polyester 50% Rayon 50%	Camel Ponte Roma
M2	0.187	Polyester 95% Spandex 5%	Navy Sparkle Sweat
M3	0.75	Cotton 100%	11oz Black Denim
M4	0.207	Cotton 65% Polyester 33% Spandex 2%	Royal Target
M5	0.198	Polyester 100%	Pink Ribbon Brown
M6	0.083	Polyester 100%	Tango Red Jet Set
M7	0.15	Polyester 100%	White Dots on Black
M8	0.065	Silk 100%	N/A
M9	0.268	Cotton 95% Spandex 5%	Ivory Rib Knit

Table S1. Experimental Cloth Materials

S1.2. Reference Friction Measurement

In order to measure the reference friction coefficient for a material/substrate pair, we employ the inclined plane protocol. As depicted in fig S1, when an object is on an inclined plane, with mass m , gravitational acceleration g , and angle of inclination α , its weight is in equilibrium as long as the tangential to the surface component, $mg \sin(\alpha)$, is equal to the frictional force \vec{Q} and the perpendicular to the surface component, $mg \cos(\alpha)$, is equal to the normal \vec{P} . As the angle α increases the tangential component increases, which remains in equilibrium up to the limit where the frictional force reaches its maximum possible value $\vec{Q} = \mu \vec{P}$. This gives the relation for the friction coefficient $\mu = Q/P = \sin(\alpha)/\cos(\alpha) = \tan(\alpha)$.

For each piece of cloth we test the angle at which it slides on every substrate. Then from the angle we compute its tangent and we use this value as a friction coefficient. We test each piece of cloth on various sections of a substrate and do not find a noticeable difference in the slippage angle.

Our resulting measurements of friction coefficient are presented in Tables S2 and S4 in the 'Reference' columns, alongside predictions made by our model. Note that our measurement is the angle of maximum inclination in equilibrium, and as we move the inclined plane with a discrete

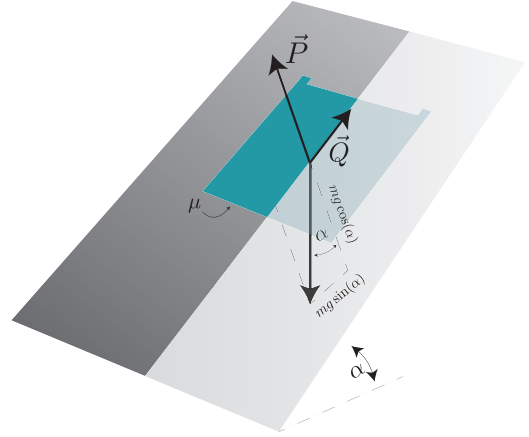


Figure S1. Inclined plane principle for frictional characterisation

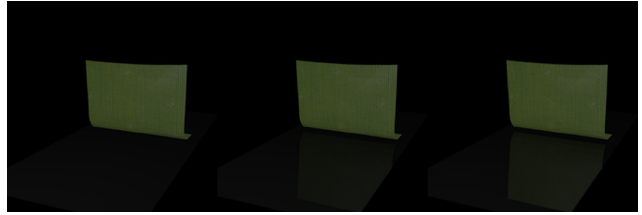


Figure S2. Multiple reflectance renderings on the substrate

interval $\delta\alpha$, the propagation of the error to the computed parameter μ is given by $\delta\mu \sim \pm \sec(\alpha)^2 \delta\alpha$.

S2. Detailed Results on Real Dataset

The detailed results of evaluating our method on the real dataset are presented below. Table S2 presents friction coefficient predictions of the model, when it has been trained on synthetic data, that has been generated without varying the reflectance of the substrate during rendering (we plot the absolute error from the reference interval in red, black and light blue curves in Figure 6). It can be observed that the model gives fairly good results on substrates that are non-reflective in the real data i.e. Aluminum, Aluminum-PET, Ceramic, and Stainless. Table S3 presents the material predictions for this scenario.

Table S4 presents friction coefficient predictions when the model has been trained with data rendered with multiple reflectance values as presented in Figure S2. The results are shown in green curve in Figure 6, where we plot the absolute error from the reference interval. The results improve significantly on reflective substrates and also improve marginally on non-reflective substrates. Table S5 presents the material predictions for this scenario.

An annotated depiction of the experimental setup for producing our real test dataset is presented in Figure S3. Figure S4 shows the experiment with various substrates.

Substrate	Aluminum		Aluminum-PET		Ceramic		Glass-Rough	
Material	Reference	Predicted	Reference	Predicted	Reference	Predicted	Reference	Predicted
M1	0.47 ± 0.06	0.5	0.38 ± 0.06	0.5	0.45 ± 0.06	0.5	0.7 ± 0.08	0.3
M2	0.36 ± 0.06	0.3	0.42 ± 0.06	0.3	0.51 ± 0.07	0.5	0.55 ± 0.07	0.1
M3	0.51 ± 0.07	0.5	0.55 ± 0.07	0.6	0.62 ± 0.07	0.6	0.62 ± 0.07	0.3
M4	0.53 ± 0.07	0.5	0.51 ± 0.07	0.5	0.67 ± 0.08	0.3	0.62 ± 0.07	0.2
M5	0.34 ± 0.06	0.4	0.38 ± 0.06	0.5	0.42 ± 0.06	0.4	0.58 ± 0.07	0.2
M6	0.45 ± 0.06	0.6	0.51 ± 0.07	0.5	0.51 ± 0.07	0.5	0.49 ± 0.06	0.3
M7	0.58 ± 0.07	0.5	0.75 ± 0.08	0.8	0.78 ± 0.08	0.5	0.87 ± 0.09	0.2
M8	0.51 ± 0.07	0.5	0.7 ± 0.08	0.7	0.9 ± 0.09	1.0	0.87 ± 0.09	0.6
M9	0.45 ± 0.07	0.9	0.45 ± 0.06	0.5	0.55 ± 0.07	0.5	0.55 ± 0.07	0.5
Substrate	Glass-smooth		Polyester-mirror		Stainless			
Material	Reference	Predicted	Reference	Predicted	Reference	Predicted		
M1	0.38 ± 0.06	0.2	0.87 ± 0.09	1.0	0.55 ± 0.07	0.6		
M2	0.38 ± 0.06	0.1	1.07 ± 0.11	0.6	0.38 ± 0.06	0.4		
M3	0.34 ± 0.06	0.2	0.73 ± 0.08	0.5	0.45 ± 0.06	0.5		
M4	0.45 ± 0.06	0.1	0.7 ± 0.08	0.7	0.49 ± 0.06	0.5		
M5	0.36 ± 0.06	0.2	0.7 ± 0.08	0.6	0.38 ± 0.06	0.6		
M6	0.51 ± 0.07	0.5	1.04 ± 0.11	0.6	0.6 ± 0.07	0.6		
M7	1.15 ± 0.12	0.5	1.23 ± 0.13	0.6	0.75 ± 0.08	0.6		
M8	1.11 ± 0.12	0.5	1.04 ± 0.11	0.5	0.67 ± 0.08	0.7		
M9	0.38 ± 0.06	0.4	0.58 ± 0.07	0.8	0.4 ± 0.06	1.0		

Table S2. Friction predictions for real data with training on single reflectance rendering

Material	Closest Class	Predicted Class
M1	Camel Ponte Roma	Royal Target
M2	Navy Sparkle Sweat	White Dots on Black
M3	11oz Black Denim	11oz Black Denim
M4	Royal Target	Royal Target
M5	Pink Ribbon Brown	White Dots on Black
M6	Tango Red Jet Set	Tango Red Jet Set
M7	White Dots on Black	White Dots on Black
M8	Not in Class (Silk)	Royal Target
M9	Ivory Rib Knit	Ivory Rib Knit

Table S3. Material predictions for real data with training on single reflectance rendering

Substrate	Aluminum		Aluminum-PET		Ceramic		Glass-Rough	
Material	Reference	Predicted	Reference	Predicted	Reference	Predicted	Reference	Predicted
M1	0.47 ± 0.06	0.5	0.38 ± 0.06	0.4	0.45 ± 0.06	0.5	0.7 ± 0.08	0.6
M2	0.36 ± 0.06	0.3	0.42 ± 0.06	0.3	0.51 ± 0.07	0.5	0.55 ± 0.07	0.5
M3	0.51 ± 0.07	0.5	0.55 ± 0.07	0.6	0.62 ± 0.07	0.6	0.62 ± 0.07	0.7
M4	0.53 ± 0.07	0.5	0.51 ± 0.07	0.5	0.67 ± 0.08	0.4	0.62 ± 0.07	0.6
M5	0.34 ± 0.06	0.4	0.38 ± 0.06	0.5	0.42 ± 0.06	0.4	0.58 ± 0.07	0.5
M6	0.45 ± 0.06	0.6	0.51 ± 0.07	0.5	0.51 ± 0.07	0.5	0.49 ± 0.06	0.5
M7	0.58 ± 0.07	0.5	0.75 ± 0.08	0.8	0.78 ± 0.08	0.5	0.87 ± 0.09	0.6
M8	0.51 ± 0.07	0.5	0.7 ± 0.08	0.7	0.9 ± 0.09	0.7	0.87 ± 0.09	1.0
M9	0.45 ± 0.06	0.6	0.45 ± 0.06	0.5	0.55 ± 0.07	0.6	0.55 ± 0.07	0.5
Substrate	Glass-smooth		Polyester-mirror		Stainless			
Material	Reference	Predicted	Reference	Predicted	Reference	Predicted		
M1	0.38 ± 0.06	0.4	0.87 ± 0.09	0.8	0.55 ± 0.07	0.6		
M2	0.38 ± 0.06	0.3	1.07 ± 0.11	1.2	0.38 ± 0.06	0.4		
M3	0.34 ± 0.06	0.3	0.73 ± 0.08	0.8	0.45 ± 0.06	0.5		
M4	0.45 ± 0.06	0.5	0.7 ± 0.08	0.7	0.49 ± 0.06	0.5		
M5	0.36 ± 0.06	0.5	0.7 ± 0.08	0.7	0.38 ± 0.06	0.5		
M6	0.51 ± 0.07	0.5	1.04 ± 0.11	0.9	0.6 ± 0.07	0.6		
M7	1.15 ± 0.12	1.2	1.23 ± 0.13	1.1	0.75 ± 0.08	0.8		
M8	1.11 ± 0.12	0.9	1.04 ± 0.11	1.1	0.67 ± 0.08	0.7		
M9	0.38 ± 0.06	0.4	0.58 ± 0.07	0.6	0.4 ± 0.06	0.5		

Table S4. Friction predictions for real data with training on multiple reflectance renderings

Material	Closest Class	Predicted Class
M1	Camel Ponte Roma	Royal Target
M2	Navy Sparkle Sweat	Navy Sparkle Sweat
M3	11oz Black Denim	11oz Black Denim
M4	Royal Target	Royal Target
M5	Pink Ribbon Brown	White Dots on Black
M6	Tango Red Jet Set	Tango Red Jet Set
M7	White Dots on Black	White Dots on Black
M8	Not in Class (Silk)	Royal Target
M9	Ivory Rib Knit	Ivory Rib Knit

Table S5. Material predictions for real data with training on multiple reflectance renderings

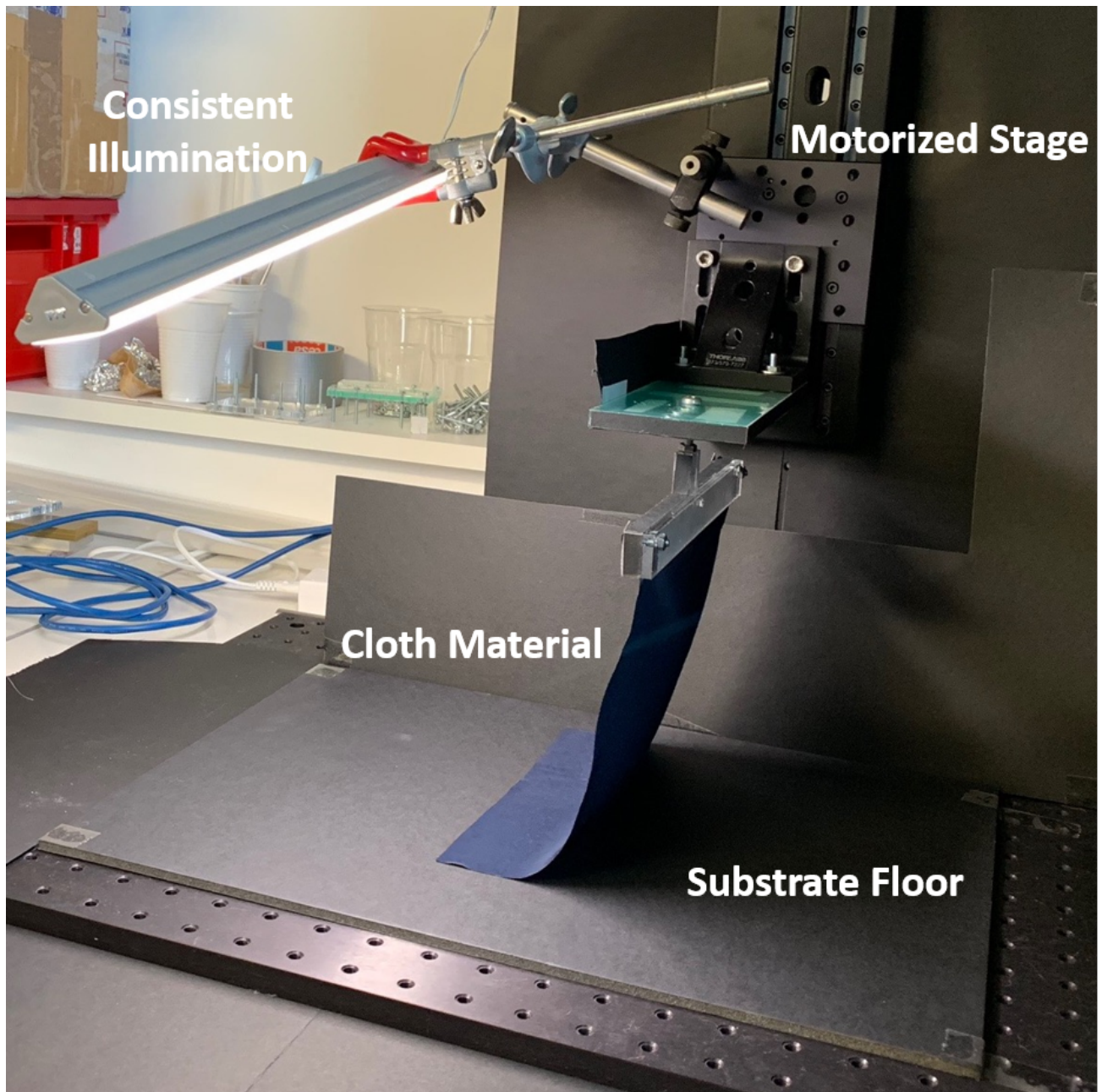


Figure S3. Experimental setup for real dataset creation

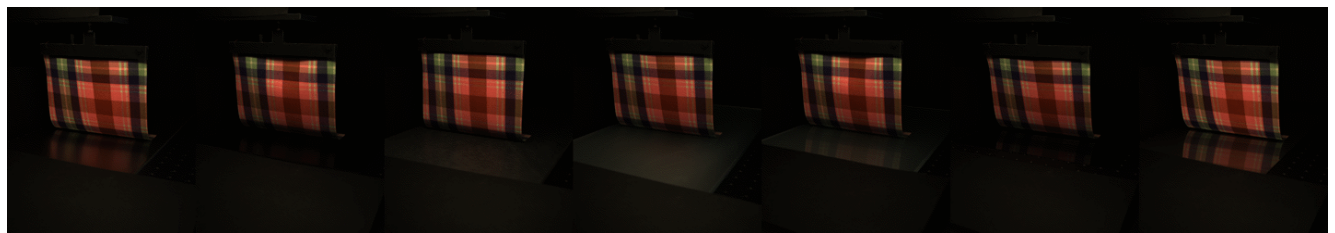


Figure S4. Experimental setup with various substrates for the same cloth material