DISCUSSION LOG

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KW13

In our cloth simulation, we follow the precedure written by Rohmer et al.. We consider to begin with the *Defomation gradient* **F**, which is defined by

$$\mathbf{F} = \frac{\partial \mathbf{x}}{\partial \mathbf{X}}, \tag{1}$$

where the **x** denotes the deformed vector and the **X** denotes the reference vector.
Since we have no further information about the mapping from **X** to **x**, we use the vector $\left(\mathbf{u_1}, \mathbf{u_2}\right)$ and $\left(\overline{\mathbf{u_1}}, \overline{\mathbf{u_2}}\right)$ to approximate the Defomation gradient, which is defined as

$$\mathbf{F} = \left[\mathbf{u_1}, \mathbf{u_2}\right] \left[\overline{\mathbf{u_1}}, \overline{\mathbf{u_2}}\right]^{-1}, \tag{2}$$

Attention should be paid especially:

- eq.(2) characrize only the 2D deformation of each triangle.
- in Rohmer et al. **F** is symbolised as **T**.

KW13

We provide here our code preceed with concrete data:

- $faces(i,j)$ is the jth vertex of the ith triangle, here we choose the $face(0,0)$, $face(0,1)$, $face(0,2)$ as examples.

cloth_vec

$$VecT = el_1 VertT_1 - el_1 VertT_2; el_1 VertT_1 - el_1 VertT_3 \tag{3}$$
$$VecR = el_1 VertR_1 - el_1 VertR_2; el_1 VertR_1 - el_1 VertR_3 \tag{4}$$

cloth_vec

$$VecT = [0.771842 \ -0.0144887 \ 6.39045] - [0.780121 \ -0.0186188 \ 6.37318] \tag{5}$$
$$[0.771842 \ -0.0144887 \ 6.39045] - [0.737177 \ -0.00912791 \ 6.3929 \tag{6}$$
$$VecR = [0.759919 \ -0.015194 \ 6.38401] - [0.767822 \ -0.0212492 \ 6.3669]; \tag{7}$$
$$[0.7599190.015194 \ 6.38401] - [0.726977 \ -0.00749985 \ 6.38692] \tag{8}$$
$$\tag{9}$$

such that

cloth_vec

$$VecT = [-0.0079\ 0.0061\ 0.0171\ 0.0329\ -0.0077\ -0.0029]; \tag{10}$$
$$VecR = [-0.0083\ 0.0041\ 0.0173\ 0.0347\ -0.0054\ -0.0025]; \tag{11}$$
$$\tag{12}$$

where the first 3 entries of $VecR$ is the vector $\mathbf{u_1}$ and the last 3 entries of $VecT$ is the vector $\mathbf{u_2}$. $VecT$ analogiously.

cloth_eig_2D

we use here *Eigen* :: *Map* to transform the vector *VecT* and *VecR* to $2 * 2$ 2D deformation gradient **F**.

$$\mathbf{F} = \begin{bmatrix} -0.0083 & 0.0347 \\ 0.0041 & -0.0054 \end{bmatrix} \begin{bmatrix} -0.0079 & 0.0329 \\ 0.0061 & -0.0077 \end{bmatrix}^{-1} \tag{13}$$

hence the $\mathbf{F}$ has a rotation information $\mathbf{R}$ and a stretch information $\mathbf{U}$,

$$\mathbf{F} = \mathbf{R}\mathbf{U}. \tag{14}$$

we use $\mathbf{F}^T\mathbf{F}$ to eliminate the ratotion information to obtain $\det \mathbf{R} = 1$

$$\begin{aligned}
\mathbf{F}^T\mathbf{F} =& \left(\mathbf{R}\mathbf{U}\right)^T\mathbf{R}\mathbf{U} && (15)\\
=& \mathbf{U}^T\mathbf{R}^T\mathbf{R}\mathbf{U} && (16)\\
=& \mathbf{U}^2 && (17)\\
=& \mathbf{C} && (18)
\end{aligned}$$

and using decomposition, if we have the form

$$\mathbf{C} = \lambda_1^2\mathbf{v}_1\mathbf{v}_1^T + \lambda_2^2\mathbf{v}_2\mathbf{v}_2^T \tag{19}$$

then we could obtain the $\mathbf{U}$ by applying

$$\mathbf{U} = \lambda_1\mathbf{v}_1\mathbf{v}_1^T + \lambda_2\mathbf{v}_2\mathbf{v}_2^T \tag{20}$$