Shadow Art Kanji: Inverse Rendering Application (SAKIRA) Abstract

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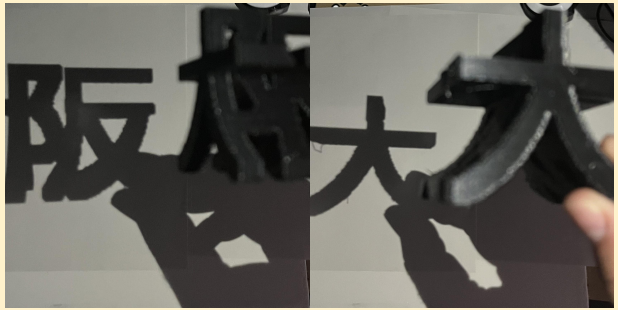
S.A.K.I.R.A.



Shadow: output 3D meshes project 1, 2, 3 Kanji shadows

Art: created for the purpose of beauty

Kanji: Chinese characters in the Japanese language

Inverse **R**endering: estimates physical attributes of a scene (i.e. determines mesh based on target shadows)

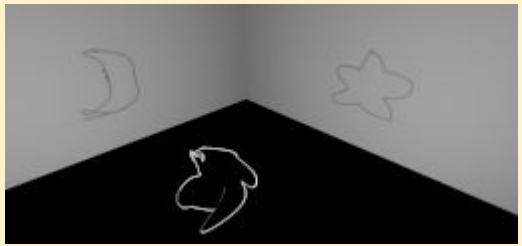
Application: this project is a usable application

Motivation

Research Goal: to create 3D-printable objects whose shadow projections become discernible Kanji characters

Inspiration

Mitsuba: use projective sampling integrators to optimize a curve into the target shadows.



Problem: in order for this model to work, the target shadows must be topologically equivalent to a circle, which most Kanji are not.

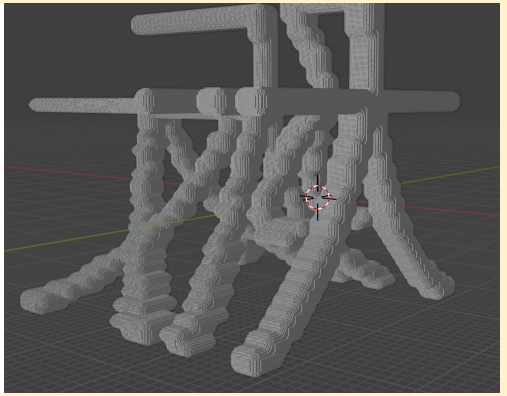
Solution: use voxels instead curve deformations!

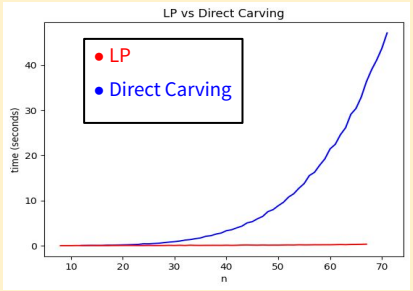
Linear Programming Model

Objective: optimize the following linear program using HiGHS to optimize efficiency

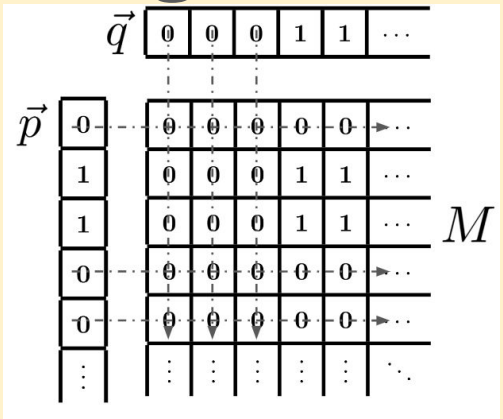
Runtime	**Theory**	**Test**
LP	$\Theta(n^6)$	$0 + n^{4.022}$
Carving	$\Theta(n^3)$	$0 + n^{2.990}$

$$\underset{T \in \mathbb{R}^{n \times n \times n}}{\text{optimize}} \sum_{i,j,k \in [n]} T_{i,j,k} \text{ s.t.} \begin{cases} \sum_{j \in [n]} T_{i,j,k} \leq nP_{i,k} & \forall i,k \in [n] \\ \sum_{i \in [n]} T_{i,j,k} \leq nQ_{j,k} & \forall j,k \in [n] \\ \sum_{k \in [n]} T_{i,j,k} \leq nR_{i,j} & \forall i,j \in [n] \\ \sum_{j \in [n]} T_{i,j,k} \geq P_{i,k} & \forall i,k \in [n] \\ \sum_{i \in [n]} T_{i,j,k} \leq Q_{j,k} & \forall j,k \in [n] \\ \sum_{k \in [n]} T_{i,j,k} \leq R_{i,j} & \forall i,j \in [n] \\ 0 \leq T_{i,j,k} \leq 1 & \forall i,j,k \in [n] \end{cases}$$

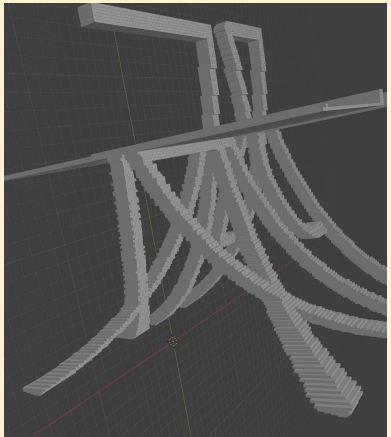




Direct Carving Model



Objective: employ a greedy, deterministic algorithm that deletes unnecessary voxels.



Results