amartyashankha / **extruded-surfaces**

Comparing changes

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base: **first_submission** ← compare: **master** ✓ **Able to merge.** These branches can be automatically merged.

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4 commits | **16** files changed | **0** commit comments | **3** contributors

Commits on May 29, 2018

Amartya Shankha Biswas	`Updates cross-sections`	91a0b16
Amartya Shankha Biswas	`Fixed quotes`	bd30ad4

Commits on Jun 13, 2018

amartyashankha	`Addressing comments.`	9050091

Commits on Jun 14, 2018

origamimagiro	`revision doc and conclusions`	7561d99

Showing 16 changed files with **505 additions** and **933 deletions**.

Unified | Split

2 70SME-style.sty

```
 \newtheorem{prop}{Proposition}
 \newtheorem{defn}{Definition}
 \newtheorem{clm}{Claim}
+\newtheorem{inv}{Invariant}
 \newtheorem{theorem}{Theorem}
 \newtheorem{lemma}{Lemma}
 \newtheorem{property}{Property}
 \newtheorem{corollary}{Corollary}
 \newtheorem{proposition}{Proposition}
 \newtheorem{definition}{Definition}
 \newtheorem{claim}{Claim}
+\newtheorem{remark}{Remark}

 % link (url/links/citation) formatting
 \RequirePackage[pdfusetitle]{hyperref}
```

14 abstract/abstract.tex

```


 \title{Efficient Origami Construction of Orthogonal Terrains \\
-using Cross-Section Evolution}
```

```
+using Cross_Section Evolution}
 \author{Amartya Shankha Biswas, Erik D. Demaine,
 and Jason S. Ku}
 \keywords{cross sections, orthogonal terrains, time evolution}
 \vspace{-0.2pc}

 In order to better communicate the algorithm and the final folded state
-produced, we also introduce a new {\bf cross-section evolution} representation
+produced, we also introduce a new {\bf cross_section evolution} representation
 of a folded isometry: a straight line is swept across the crease pattern of a
 folded surface, and we keep track of how the folding of the line evolves as a
-cross-section of the folded surface. The propagation of the cross-section
+cross_section of the folded surface. The propagation of the cross_section
 between crease pattern vertices is uniquely determined by the initial
-orientation of the cross-section, so the folded isometry can be constructed by
-sweeping the line and locally modifying the cross-section when crossing crease
+orientation of the cross_section, so the folded isometry can be constructed by
+sweeping the line and locally modifying the cross_section when crossing crease
 pattern vertices during propagation. This representation not only simplifies the
 description of the 3D folded isometries constructed, but also provides a simpler
 framework to argue that the folded state does not self intersect, by propagating
-planar cross-sections monotonically along a single direction. We then
+planar cross_sections monotonically along a single direction. We then
 show that our construction's efficiency is within a small constant factor of
 any folding with optimal efficiency.

 \begin{figure}
   \centering
   \includegraphics[width=\linewidth]{Figures/fig2sm.pdf}
-  \caption{Snapshots of a cross-section evolution for two gadgets used to
+  \caption{Snapshots of a cross_section evolution for two gadgets used to
 construct orthogonal terrains. The sequence on top shows a level-shifting gadget
 that changes the height of a section via the use of auxiliary pleats to tuck
 away excess paper. The sequence on the bottom shows a paper-absorbing gadget
```

30 cross_sections/cross_sections.tex

```

 We introduce a new method of origami construction, using cross section diagrams.
 Instead of beginning our construction from a 2-dimensional sheet of paper, we
-consider a 1-dimensional cross section moving forwards in time. A simple example
-using strip narrowing\cite{strip_narrowing} is demonstrated in
+consider a 1-dimensional cross section moving forwards in time through 3D space.
+A simple example using strip narrowing\cite{strip_narrowing} is demonstrated in
 Figure~\ref{fig:strip_narrowing}.

 \subsection{Segments and Cross Sections}
 such that for every segment $s_i$ (except the last),
 the right endpoint of $s_i$ coincides with the left endpoint of $s_{i+1}$.
 Each segment $s$ is also associated with a velocity vector $\vec{\hat v_s}$ of unit magnitude.
-For a segment $s\in C$ we will also denote this velocity as $\vec{\hat v_i}$.
-\end{definition}
-
-\begin{definition}
-\label{def:node}
-Given a cross section $C = \langle s_1, s_2,\cdots s_n \rangle$, a node $x$ denotes a point on one of the segments
 $s_i$.
```

```
-A joint node is a node that resides on the endpoint of a segment.
-The distance between two nodes on a cross section is defined as the overall length of cross section between the two
 nodes.
+For a segment $s_i\in C$ we will also denote this velocity as $\vec{\hat v_i}$.
 \end{definition}

 \vspace{-1pc}
-\begin{restatable}{pro}{UniformVelocity}
-\label{pro:uniform_velocity}
-All non-joint nodes on a segment $s$ move with the same velocity $\vec{\hat v_s}$.
+\begin{restatable}{inv}{UniformVelocity}
+\label{inv:uniform_velocity}
+All non-joint nodes on a segment $s$ have the same velocity $\vec{\hat v_s}$.
 \end{restatable}
 \vspace{-1pc}

-\begin{restatable}{pro}{OrthogonalVelocity}
-\label{pro:orthogonal_velocity}
+\begin{restatable}{inv}{OrthogonalVelocity}
+\label{inv:orthogonal_velocity}
 The velocity $\vec{\hat v_s}$ of segment $s$ is orthogonal to its orientation $\vec{\hat o_s}$.
 \end{restatable}

+\begin{definition}
+\label{def:node}
+Given a cross section $C = \langle s_1, s_2,\cdots s_n \rangle$, a node $x$ denotes a point on one of the segments
 $s_i$.
+A joint node is a node that resides on the endpoint of a segment.
+The distance between two nodes on a cross section is defined as the overall length of cross section between the two
 nodes.
+\end{definition}
+
 \input{cross_sections/joints}
 \input{cross_sections/evolution}
 \input{cross_sections/folding}
```

24 cross_sections/evolution.tex

```

 \begin{definition}
 \label{def:segment_length}
-For ever segment $s$ in a cross section $C$, we associate a left pace $L_s$,
+For every segment $s$ in a cross section $C$, we associate a left pace $L_s$,
 which indicates the rate at which $s$ shrinks from its left endpoint.
 Similarly, we define a right pace $R_s$ grows from its right endpoint.
 Note that both these quantities can be negative.
 \vec J_v^L-\vec{\hat v_{s_i}} = L_{s_i}\cdot \vec{\hat o_{s_i}}, && \vec J_v^R-\vec{\hat v_{s_i}} = R_{s_i}\cdot
 \vec{\hat o_{s_i}}.
 \end{align*}

-\begin{proposition}
-\label{prop:valid_joint}
+\begin{definition}
+\label{def:valid_joint}
 A joint $J$ corresponding to segments $s$ and $t$ is \emph{valid} if and only if the evolution
 resulting from the velocities $\vec{\hat v_l}$, $\vec{\hat v_r}$, and $\vec J_v$ preserves distances between nodes.
-\end{proposition}
```

```diff
+\end{definition}
 \vspace{-1pc}
-\begin{restatable}{pro}{LeftRightPace}
-\label{pro:left_right_pace}
+\begin{restatable}{inv}{LeftRightPace}
+\label{inv:left_right_pace}
 The right pace of $s_{i}$ is equal to the left pace of $s_{i+1}$.
 This is to preserve the overall length of the cross section, and the distance between any two nodes.
 Furthermore, the left pace of the first segment, and the right pace of the last segment should be zero, i.e., $L_0 = R_n = 0$
 \end{align*}
 This is only possible if $\vec{\hat o_l}\times \vec{\hat o_r}$ is oriented opposite to $\vec{\hat v_l}^\shortparallel\times \vec{\hat v_r}^\shortparallel$.

-\begin{restatable}{pro}{SegmentOrientation}
-\label{pro:SegmentOrientation}
+\begin{restatable}{inv}{SegmentOrientation}
+\label{inv:SegmentOrientation}
 Given two adjacent segments $l$ and $r$ in a cross section $C$, the vector
 $\vec{\hat o_l}\times \vec{\hat o_r}$ must be oriented opposite to $\vec{\hat v_l}^\shortparallel\times \vec{\hat v_r}^\shortparallel$.
 \end{restatable}

 If the angle between the segments (between $\vec{\hat o_l}$ and $\vec{\hat o_r}$) is $\theta$,
 the magnitude of $\vec{\hat o_r}-\vec{\hat o_l}$ is $\sqrt{2-2\cos(\theta)}$,
 and $ \left\| \vec{\hat v_r}^\shortparallel-\vec{\hat v_l}^\shortparallel\right\| = v\cdot\sqrt{2-2\cos(\pi-\theta)}$.
-Here, $v$ is magnitude of the plane velocity of $J_i$. Given $\phi = \theta/2$, we get --
+Here, $v$ is magnitude of the plane velocity (projection onto the joint plane
+$\mathcal P$) of $\vec J_i$.
+Given $\phi = \theta/2$, we get --
 \begin{align*}
 -L = -R &= \frac dt = \vec{\hat v_l} - \vec{\hat o_l}\frac{ \left\| \vec{\hat v_r}^\shortparallel
 - \vec{\hat v_l}^\shortparallel\right\|}{ \left\| \vec{\hat o_r}-\vec{\hat o_l}\right\|}
 = v\cdot\frac{\sqrt{\sin^2\left( {\pi/2-\theta/2}\right)}}{\sqrt{\sin^2{\theta/2}}}
 = v\cdot\cot\left( \phi \right).
 \end{align*}

-\begin{restatable}{pro}{JointVelocity}
-\label{pro:joint_velocity}
+\begin{restatable}{inv}{JointVelocity}
+\label{inv:joint_velocity}
 The velocity of a joint $J$ associated with segments $l$ and $r$, is a constant vector
 $\vec J_v
 %= \vec{\hat v_l} - \vec{\hat o_l}\frac{ \left\| \vec{\hat v_r}^\shortparallel
```

22 cross_sections/folding.tex

```diff
 $Z_s = LL'R'R$ is the corresponding trapezoid (Figure~\ref{fig:segment_trapezoid}).
 \end{lemma}
 \begin{proof}
-By Property~\ref{pro:joint_velocity}, we know that the joint trajectories are straight lines, which form the non-parallel sides.
+By Invariant~\ref{inv:joint_velocity}, we know that the joint trajectories are straight lines, which form the non-parallel sides.
 Since the non-joint nodes on a segment all have the same velocity, the initial and final segment positions form the parallel sides.
 \end{proof}
```

```
 \begin{proof}
 We consider the evolution of joint $J$ for time $T$ (Figure~\ref{fig:trapezoid_angles}).
 First consider a coordinate system with $(\vec{\hat v_l}, \vec{\hat o_l})$ as the basis.
-Since, $\vec{\hat v_l} = \vec v_l^\shortparallel$, from Property~\ref{pro:joint_velocity},
+Since, $\vec{\hat v_l} = \vec v_l^\shortparallel$, from Invariant~\ref{inv:joint_velocity},
 we know that $-R_l = \left\| \vec v_l^\shortparallel\right\|\cdot\vec{\hat o_v}\cdot\cot(\phi) = \vec{\hat
 o_v}\cdot\cot(\phi)$.
 So, $\vec J_v = \vec{\hat v_l} - \vec{\hat o_v}\cdot\cot(\phi)$.  Therefore,
 \begin{align*}
     \cot(\angle LJJ') &= \frac{\left\| T\cdot R_l\right\|}{ \left\| T\cdot(\vec J_v - R_l)\right\|} = \cot(\phi)
     \implies \angle LJJ' = \phi.
 \end{align*}
-Similarly, we consider a coordinate system with $(\vec{\hat v_l}, \vec{\hat o_l})$ as the basis.
+Similarly, we consider a coordinate system with $(\vec{\hat v_r}, \vec{\hat o_r})$ as the basis.
 Since $\vec J_v = \vec{\hat v_r} - \vec{\hat o_r}\cdot \cot(\phi)$, we get
 $$
 \cot(\angle RJJ') = \frac{-\left\| T\cdot L_r\right\|}{ \left\| T\cdot(\vec J_v - L_r)\right\|} = -\cot(\phi)
 \label{def:interval_folding}
 Consider a cross section interval $\mathcal C$ formed from a cross section $C$ evolving over time $T$.
 By Lemma~\ref{lem:trapezoid}, the segments $ \langle s_1, s_2,\cdots s_n \rangle$ form trapezoids
-$ \langle Z_1, Z_2,\cdots Z_n \rangle$ each of height $T$.
+$ \langle Z_1, Z_2,\cdots Z_n \rangle$ each of height $T$, where $Z_i$ represents the $i^{th}$ trapezoid in folded
 space.
 The folding $\mathcal F_C^T$ corresponding to $\mathcal C$ is formed by successively gluing the trapezoids
-$Z_i$ to $Z_{i+1}$ along the trajectory of joint $J_i$ (for $1\le i<n$) to form a connected shape.
+$Z_i$ to $Z_{i+1}$ along the trajectory of joint $\vec J_i$ (for $1\le i<n$) to form a connected shape.
 \end{definition}

 \begin{definition}
 Similarly, the final-boundary of $\mathcal F_C^T$ is defined as the union of the final segments in $\mathcal C_F$.
 \end{definition}

-\begin{theorem}
+\begin{restatable}{thm}{interval_strip}
 \label{thm:interval_strip}
 Consider a cross section interval $\mathcal C$ formed from a cross section $C$ evolving over time $T$ to form a folding
 $\mathcal F_C^T$.
 Further assume that the total length of cross section $C$ is $X$ units. Then, $\mathcal F_C^T$ is isometric to a
 $X\times T$ strip of paper.
-\end{theorem}
+\end{restatable}
 \begin{proof}
 By repeated use of Lemma~\ref{lem:trapezoid_gluing}, we know that $\mathcal F_C^T$ is isometric to a trapezoid.
 Let $L,L'$ be the initial and final positions of the left (non-parallel) edge of the trapezoid, and
 let $R,R'$ be the initial and final positions of the right edge of the trapezoid.
 Say that $C$ comprises of segments $ \langle s_1, s_2,\cdots s_n \rangle$.
-From Property~\ref{pro:left_right_pace}, we know that the left pace of $s_0$ is zero.
+From Invariant~\ref{inv:left_right_pace}, we know that the left pace of $s_0$ is zero.
 So, the line $LL'$ follows the trajectory of $\vec{\hat v_0}$, which is orthogonal to the segment $s_0$.
 In other words, the left edge of the trapezoid has length $T$, and is orthogonal to the parallel edges.
 Similarly, because the right pace of $s_n$ is zero, the right edge of the trapezoid is also orthogonal.
 Therefore, $\mathcal F_C^T$ is isometric to a right angled trapezoid (i.e., a strip) of length $X$ and width $T$.
 \end{proof}

-\begin{proposition}
-\label{prop:joint_crease}
```

```
+\begin{remark}
+\label{rem:joint_crease}
 The trajectory of a joint forms a crease in the folded state.
-\end{proposition}
+\end{remark}
```

20 cross_sections/joints.tex

```

 \begin{definition}
 \label{def:joints}
-A cross section with $n$ segments is also associated with a list of joints $ \langle J_1,\cdots J_{n-1} \rangle$,
-where $J_i$ corresponds to the right endpoint of $s_i$ (same as left endpoint of $s_{i+1}$.
-A particular joint $\vec J_i$ is associated with a left segment $s_i$, a right segment $s_{i+1}$, and a velocity $\vec
 J_v$.
+A cross section with $n$ segments is also associated with a list of joints
+$ \langle \vec J_1,\cdots \vec J_{n-1} \rangle$,
+where $\vec J_i$ corresponds to the right endpoint of $s_i$ (same as left endpoint of $s_{i+1}$.
+A particular joint $\vec J_i$ is associated with a left segment $s_i$,
+a right segment $s_{i+1}$, and a velocity $\vec J_v$.
 \end{definition}

 \begin{definition}
 \label{def:joint_plane_velocity}
 Consider a joint $J$ associated with segments $l$, $r$, and joint plane $\mathcal P$,
 where $\vec{\hat v_l}$ and $\vec{\hat v_r}$ are the velocities of segments $l$ and $r$.
-We define $\vec{\hat v_l}^\shortparallel$ and $\vec{\hat v_l}^\perp$ as the components of $\vec{\hat v_l}$ coinciding
 with,
-and orthogonal to $\mathcal P$ respectively.
+We define $\vec{\hat v_l}^\shortparallel$ and $\vec{\hat v_l}^\perp$ as components of
+$\vec{\hat v_l}$, such that $\vec{\hat v_l}^\shortparallel$ is the projection of $\vec{\hat v_l}$
+onto $\mathcal P$, and $\vec{\hat v_l}^\perp = \vec{\hat v_l} - \vec{\hat v_l}^\shortparallel$
+(orthogonal to $\mathcal P$).
 Similarly, we define $\vec{\hat v_r}^\shortparallel$ and $\vec{\hat v_r}^\perp$, as the components of $\vec{\hat v_r}$.
-By Property~\ref{pro:orthogonal_velocity}, $\vec{\hat v_l}^\shortparallel$ and $\vec{\hat v_r}^\shortparallel$
+By Invariant~\ref{inv:orthogonal_velocity}, $\vec{\hat v_l}^\shortparallel$ and $\vec{\hat v_r}^\shortparallel$
 are orthogonal to $\vec{\hat o_l}$ and $\vec{\hat o_r}$ respectively.
 This uniquely determines the direction of all velocity components.
 \end{definition}

 Henceforth, we will refer to the $\vec{\hat v}^\shortparallel$ component as the \emph{joint plane velocity},
 and the $\vec{\hat v}^\perp$ component as the \emph{joint orthogonal velocity,}

-\begin{restatable}{pro}{JointOrthogonalVelocity}
-\label{pro:joint_orthogonal_velocity}
+\begin{restatable}{inv}{JointOrthogonalVelocity}
+\label{inv:joint_orthogonal_velocity}
 For a joint $J$ associated with segments $l$ and $r$, $\vec{\hat v_l}^\perp = \vec{\hat v_r}^\perp$
 i.e. the joint orthogonal velocities have to be equal, such that the joint plane moves with a fixed velocity along it's
 normal.
 As a corollary, $ \left\| \vec{\hat v_l}^\shortparallel\right\| = \left\| \vec{\hat v_r}^\shortparallel\right\|$.
```

20 cross_sections/multiple.tex

```

 \begin{proposition}
 \label{prop:creases}
-In addition to the creases formed along the trajectory of joints (Proposition~\ref{prop:joint_crease}),
```

```
+In addition to the creases formed along the trajectory of joints (Remark~\ref{rem:joint_crease}),
 creases are also created when a segment changes velocity.
 For instance, consider two adjacent cross sections $\mathcal C$ and $\mathcal D$,
 with corresponding segments $s_C\in \mathcal C_F$ and $s_D\in \mathcal D_I$,
 \label{thm:main}
 Consider a cross section sequence $\mathcal C = \langle \mathcal C_1, \mathcal C_2,\cdots \mathcal C_m \rangle$ where each
 cross section interval $\mathcal C_i$ evolves over time $T_i$ to form a folding $\mathcal F_i$
-such that the following properties hold for all segments and joints in each of the cross sections involved.
-\begin{itemize}
-    \item[] \vspace{-1.6em}\UniformVelocity*
-    \item[] \vspace{-1.6em}\OrthogonalVelocity*
-    \item[] \vspace{-1.6em}\JointOrthogonalVelocity*
-    \item[] \vspace{-1.6em}\LeftRightPace*
-    \item[] \vspace{-1.6em}\SegmentOrientation*
-    \item[] \vspace{-1.6em}\JointVelocity*
-\end{itemize}
+such that Invariants~1-6 hold for all segments and joints in each of the cross sections involved.
+%\begin{itemize}
+    %\item[] \vspace{-1.6em}\UniformVelocity*
+    %\item[] \vspace{-1.6em}\OrthogonalVelocity*
+    %\item[] \vspace{-1.6em}\JointOrthogonalVelocity*
+    %\item[] \vspace{-1.6em}\LeftRightPace*
+    %\item[] \vspace{-1.6em}\SegmentOrientation*
+    %\item[] \vspace{-1.6em}\JointVelocity*
+%\end{itemize}
 Then, the folding $\mathcal F_{\mathcal C}$ obtained by successively gluing the final boundary of $\mathcal F_i$ to the initial boundary
 of $\mathcal F_{i+1}$ (for each $1\le i<m$), is isometric to a $X\times T$ strip of paper, where $T = \sum T_i$.
 \end{restatable}
```

12 introduction.tex

```
 exists above the terrain. This result improves an algorithm,
 \cite{BoxPleating_Origami5} also presented at 5OSME, applicable to a more
 general class of inputs, providing a universal construction to fold general
-orthogonal polyhedra, though the construction is less inefficient than our
+orthogonal polyhedra, though the construction is less efficient than our
 construction applied to orthogonal terrains. Our construction approach follows
 three steps:

 \vspace{-0.2pc}

 In order to better communicate the algorithm and the final folded state
-produced, we also introduce a new {\bf cross-section evolution} representation
+produced, we also introduce a new {\bf cross section evolution} representation
 of a folded isometry: a straight line is swept across the crease pattern of a
 folded surface, and we keep track of how the folding of the line evolves as a
-cross-section of the folded surface. The propagation of the cross-section
+cross section of the folded surface. The propagation of the cross section
 between crease pattern vertices is uniquely determined by the initial
-orientation of the cross-section, so the folded isometry can be constructed by
-sweeping the line and locally modifying the cross-section when crossing crease
+orientation of the cross section, so the folded isometry can be constructed by
+sweeping the line and locally modifying the cross section when crossing crease
 pattern vertices during propagation. This representation not only simplifies the
 description of the 3D folded isometries constructed, but also provides a simpler
```

```
 framework to argue that the folded state does not self intersect, by propagating
-planar cross-sections monotonically along a single direction. We then
+planar cross_sections monotonically along a single direction. We then
 show that our construction's efficiency is within a small constant factor of
 any folding with optimal efficiency.
```

15 main.tex

```
 
 \input{orthogonal/orthogonal}
 
+\section{Conclusion}
+
+This paper provides a universal construction to fold orthogonal terrains that is
+optimally efficient over its domain, improving upon previous constructions that
+were less efficient but applicable to a more general class of target shapes,
+i.e., orthogonal polyhedra. Some natural questions arise. Can one improve the
+efficiency of the construction for a more restricted set of terrains? For
+example, our lower bound is achieved by a maximum height-difference
+checkerboard; perhaps one can improve folding efficiency for terrains that are
+more slowly varying. Our construction only covers the terrain from above,
+allowing the folding to exist anywhere in the space below the terrain. This
+allocation is necessary when points of the terrain have more than $2\pi$
+material at a point. What is the minimum area of paper that can exist away from
+the target terrain over all possible foldings?
+
 \section*{Acknowledgments}
 
 We thank Martin Demaine, Herng Yi Cheng, Aviv Ovadya, and Tomohiro Tachi
```

9 orthogonal/construction.tex

```
 \label{sec:column_extrusion}
 
 First, we consider a single column (Figure~\ref{fig:column_extrusion})
-of the orthogonal terrain $\left\{ E_{i1}, E_{i2}, \cdots, E_{i,n} \right\}$.
+of the orthogonal terrain $\left\{ E_{i,1}, E_{i,2}, \cdots, E_{i,n} \right\}$.
 We denote the column extrusion heights as $\left\{ H_1, H_2,\cdots H_n \right\}$, where $H_j = E_{i,j}$.
 Consider the decomposition of $T$ into the following time intervals:% (parallel to the $x$-axis):
 \begin{align}
 a sequence of $2k$ horizontal segments that \emph{accordion} back and forth.
 During each $1$-interval, all segments move along the positive $y$ direction (Figure~\ref{fig:level_shift0}),to create the $i$th level.
 Subsequently, during the level shift, all segments move in the $x-z$ plane (Figure~\ref{fig:level_shift1},~\ref{fig:level_shift2}).
-\begin{property}
+\begin{restatable}{pro}{AccordionEven}
 \label{pro:accordion_even}
 The number of accordion folds during horizontal evolution (along the $y$ axis) must be even.
-\end{property}
+\end{restatable}
 
 The top segment moves downwards in intervals of $2\varepsilon$.
 During this process, the horizontal segments move downwards continuously (Figure~\ref{fig:level_shift1},~\ref{fig:level_shift2}).
 \end{align*}
 %X\ge 1 + 2\cdot\left( \max\left\{ H_i\right\}-\min\left\{ H_i\right\}\right) &&T \ge \left( m + \sum\limits^{m-1}_{i=1} \left| H_{i+1}-H_i\right|\right)
```

```
 \end{theorem}
-
-\input{orthogonal/grid}
-\input{orthogonal/connector}
```

4 orthogonal/grid.tex

```

 Now, we consider multiple column extrusions evolving in parallel.
 Henceforth, we will refer to the evolution of column cross sections along the $y$-axis
-(the ''1''s in Equation~\ref{eq:column_decomposition} as \emph{horizontal evolution}.
+(the ``1''s in Equation~\ref{eq:column_decomposition}) as \emph{horizontal evolution}.
 Meanwhile, a \emph{vertical transition} will refer to level shifting evolution in the $x-z$ plane.
 Let $\mathcal C^{(i)}$ be a valid cross section evolution corresponding
 to the $i$th column in the grid extrusion (as defined in Section~\ref{sec:column_extrusion}).
 up-down gadgets (each gadget \emph{stalls} for $2\varepsilon$ time).
 %Notice that this gadget requires at least one accordion segment. In fact, by Lemma~\ref{lem:accordion_even}, it requires two segments.
 %Given the worst case scenario, where $E_{i,j}=E_{i,j+1}$ is the max height in column $i$,
-We obtain the following primitive, as a consequence of Theorem~\ref{thm:column_extrusion}.
+We obtain the following proposition, as a consequence of Theorem~\ref{thm:column_extrusion}.

 \begin{proposition}
 \label{prop:accordion_layers}
```

4 orthogonal/orthogonal.tex

```
     \label{fig:column_extrusion}
     \vspace{-0.8em}
 \end{wrapfigure}
-We consider each ''column'' of a given grid extrusion separately
+We consider each ``column'' of a given grid extrusion separately
 as an individual \emph{column extrusion} (Figure~\ref{fig:column_extrusion}).
 We will construct each of the $n$ columns independently (Figure~\ref{fig:level_shift}),
 and attach them together with \emph{column connectors} (Figure~\ref{fig:column_connector}).
 %Imagine that there are $T = \frac Y\varepsilon$ time steps of length $\varepsilon$, over which the cross section evolves along the $y$-axis.

 \input{orthogonal/construction}
+\input{orthogonal/grid}
+\input{orthogonal/connector}
 \input{orthogonal/size}
 \input{orthogonal/optimal}
 %\input{orthogonal/assumption}
```

178 reviews_7osme.txt

227 reviews_7osme_response.txt

855 temp.vim

2 title.tex

```
@@ -1 +1 @@
-\title{Efficient Origami Construction of Orthogonal Terrains using Cross-Section Evolution}
```

```
1 +\title{Efficient Origami Construction of Orthogonal Terrains using Cross_Section Evolution}
```

No commit comments for this range