2D Polygonal Mesh Draining via Parametric AI Search

by

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University of California, Berkeley

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Abstract

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This is the part that explains the paper.

To Ossie Bernosky

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Acknowledgments

To everyone who helped me along this journey.

Chapter 1

Background

TODO

Chapter 2

Introduction & Motivation

A paragraph about manufacturing work pieces and jet cleaning

A paragraph about draining the fluid after cleaning. Oven approach vs rotating / draining approach.

Exisiting research [1] has been conducted to determine the "drainability" of workpieces. "Drainability" in this sense refers to the ability for a part to be fully drained by an infinite number of rotations about a particular axis. Water particles move between concave vertices while the workpiece is being rotated; they eventually either leave the workpiece or enter a cycle in the draining graph.

Existing software can sample all rotation axes over the Gaussian Sphere and produce a map of which rotation axes contain loops in the draining graph. These rotation axes that contain loops cannot be drained by an infintie number of rotations, so manufacturers know to produce fixtures that rotate the workpiece along a different axis.

Once an axis is chosen however, manufacturers have no way of knowing the duration of rotation needed. They also do not know the optimal speed of rotation (the speed that guarantees draining in the shortest amount of time). Because of this, there still exists a gap between the theoretical results of drainability and the implementation in industry.

Furthermore, the existing research only calculates drainability for rotation in one direction. It is fairly easy to imagine parts that are undrainable with rotations in solely one direction, but easily drainable with rotations in two directions. Omitting the possibility of bi-directional draining unncessarily reduces the set of workpieces that are considered "drainable."

This paper aims to bridge the gap between drainability analysis and industry implementation. Similar drainability analysis results will be produced, but a final control sequence of the rotation angle of the workpiece will be produced. Furthermore, bi-directional draining solutions will be produced, further expanding the set of workpieces that can be drained. These two objectives give rise to a fairly different approach than existing research.

Chapter 3

Physical Simulation of Water Particles

3.1 Basic Formulation

Here we talk about how water particles must be simulated as part of the drainability analysis calculation.

Many methods – smoothed hydrodynamic particles, etc etc

Another approach is to simply construct the kinematic equations and integrate in time. Euler's method, etc

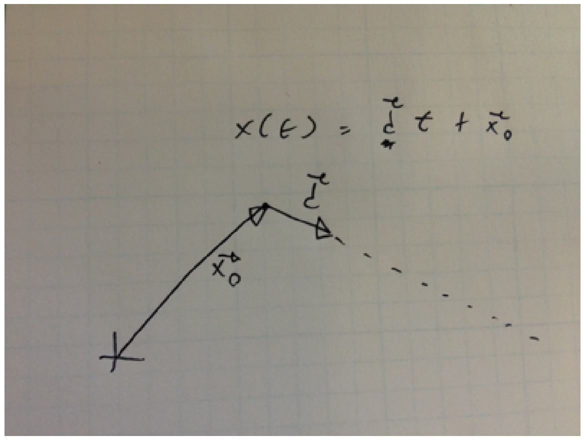
We will examine a parametric approach.

Parametric Equations (rays)

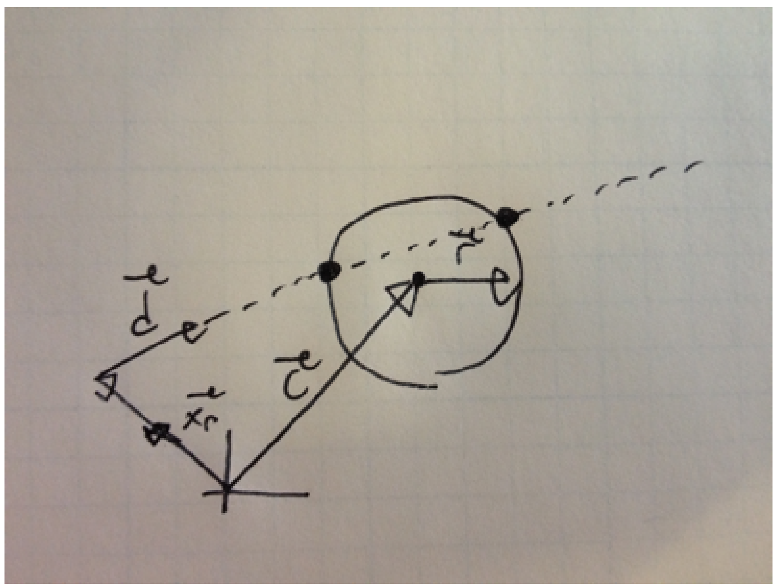
Parametric rays look like this (equation).

Geometric Primitive Intersections

Once parametric rays are defined, you can easily intersect them with geometric primitives



Example of sphere ray intersection equation.



3.2 Previous Work

Infinitesimally Slow Rotations

Inelastic Collisions

Kinetic Energy Limitation

3.3 Adaption to Finite Angular Velocities

Parametric Equation Modification

Free Fall Equation

Rolling Equation

Concurrent Rotation & Rolling Equation

Assumption #1 - No concurrent Rotation + Freefall

Elastic Collisions

Planar Collision

Rolling-Edge Collision

Rolling-Corner Collision

Conservation of Momentum

Settling Guarantee

Duration of Simulation

3.4 Results

Run Time

Accuracy Comparison

With Euler Integration

3.5 Future Work & Discussion

Bounding Box Method Adaption

Bounded Simulation Between Limits

Chapter 4

Solution Search

4.1 General A.I. Search

State Space

State Space Exploration

4.2 Adaption of A.I. Search

Traditional Formulation

Our State Space Formulation

Exploration

4.3 Transition Function

Definition

Sampling

Representative Coverage Between Limits

Graph Search

Cost Sensitive Closed List

4.4 Search

Uniform Cost Search

Cost Function

Time

Energy - Rotation Angle

Energy - Workpiece Center of Gravity

Chapter 5

Conclusion

TODO

Bibliography

[1] James Moorer. “Signal Processing Aspects of Computer Music–A Survey”. In: *Computer Music Journal* 1.1 (1977).