

Transient 3D FE method for predicting extrudate swell for domains containing sharp edges

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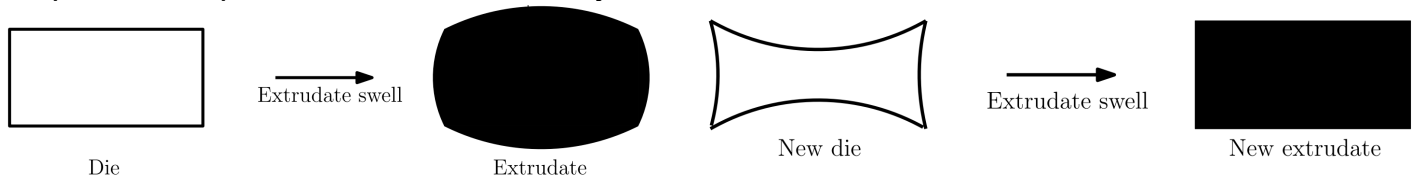


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Introduction

Extrusion is widely used in the polymer processing industry. Common requirement on extrudate: **dimensional precision** → dimensions highly influenced by extrudate swell.

Experimental procedure that is currently used to obtain extrudate with desired dimensions:



→ Repeated until desired dimensions are obtained: time consuming and inefficient.
Solution: numerically predict extrudate swell

Method

Sharp corners (red) swell in two directions. Obtain positions of the corner lines using a material line description:

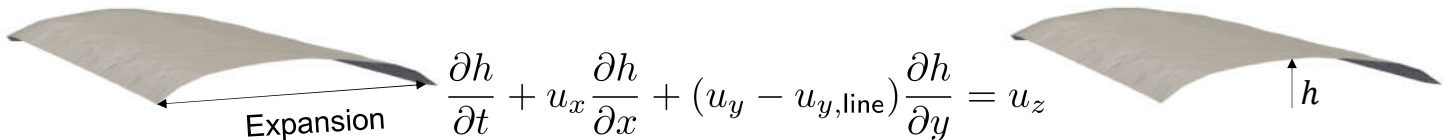
$$\frac{\partial \mathbf{x}}{\partial t} + u_x \frac{\partial \mathbf{x}}{\partial x} = \mathbf{u}_{2D}$$



Free surfaces: 2D height problems

- Surfaces expand due to movement of the corner lines, use corner line positions for expansion:

- Expanded surfaces swell:

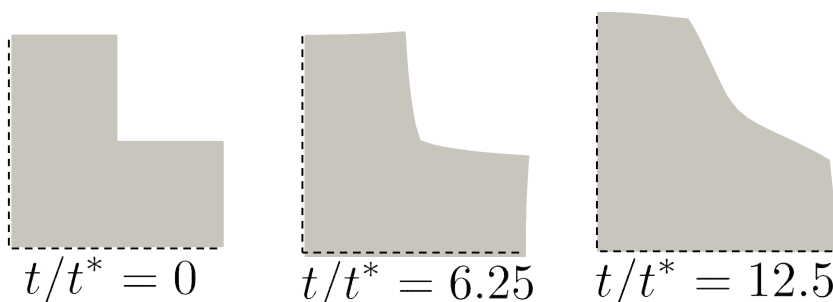


Time stepping:



Results

Transient swelling for a cross-section of a 3D complex



Conclusion:

- New transient FE method developed.
- Sharp edges are contained over both time and long distance in the extrudate.
- Transient extrudate swell prediction is now possible for complex die shapes and complex fluids.