SIMPLEOPT

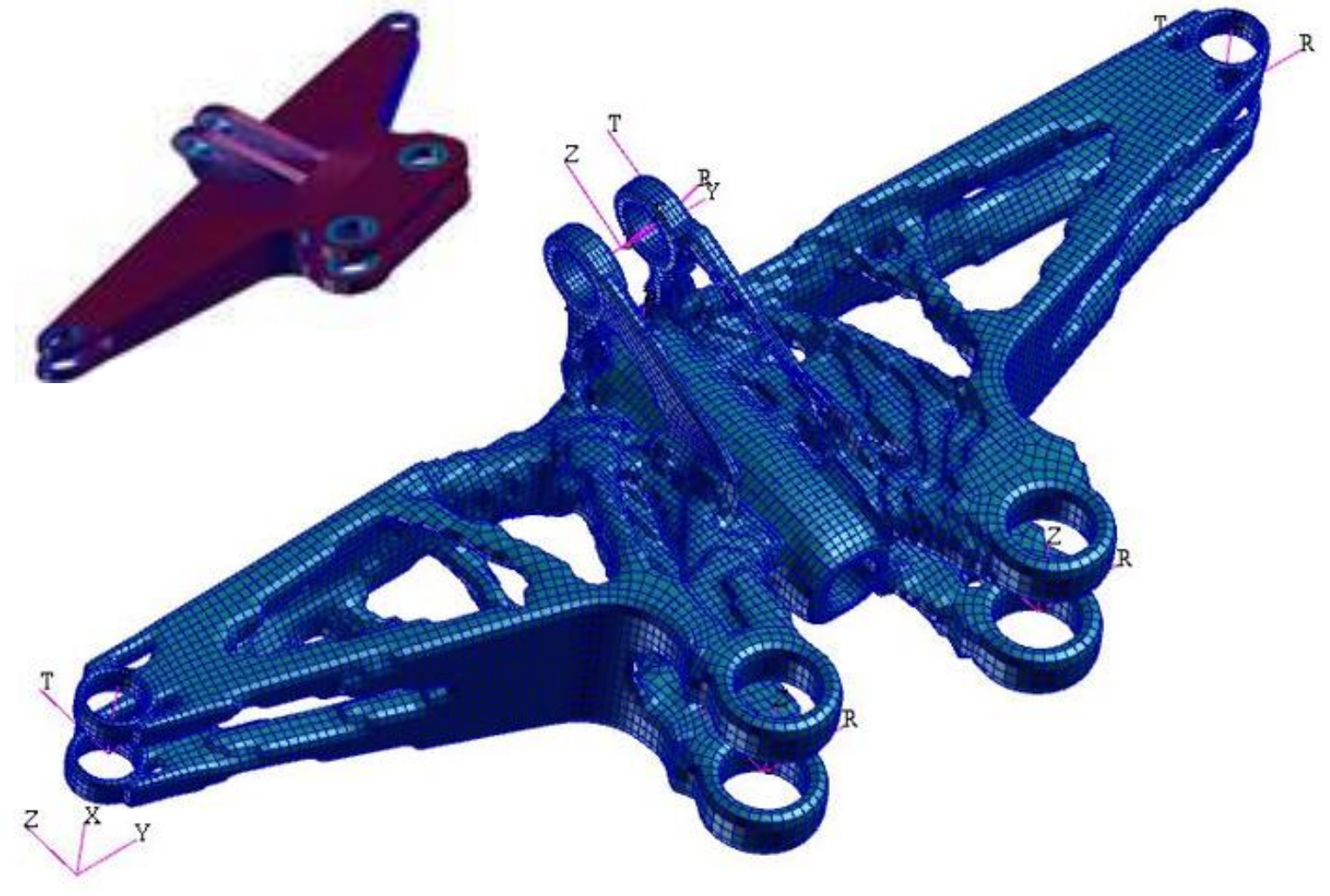## A SIMPLIFIED TOPOLOGY OPTIMIZATION PROGRAM

Michael Miller

MATH 198

10/14/12

What is Topology Optimization?

- A method of designing better parts
- Pick parameters
  - Shape
  - Weight
  - Strength
- Computer designs the part

Topology Optimization Example

Why T.O.?

- Beneficial with little to no negative effect
  - Usually optimizing is a give and take process

- Growing in modern industries
  - Cheaper
  - Weight

Project Goals

Topology Optimization is beneficial, but impractical
- Time
- Computationally demanding

Can the T.O. process be simplified to negate these problems?
- Two dimensions instead of three
- Swap *Toy Physics* for real physics

How SimpleOpt Works

1. Finite Element Analysis

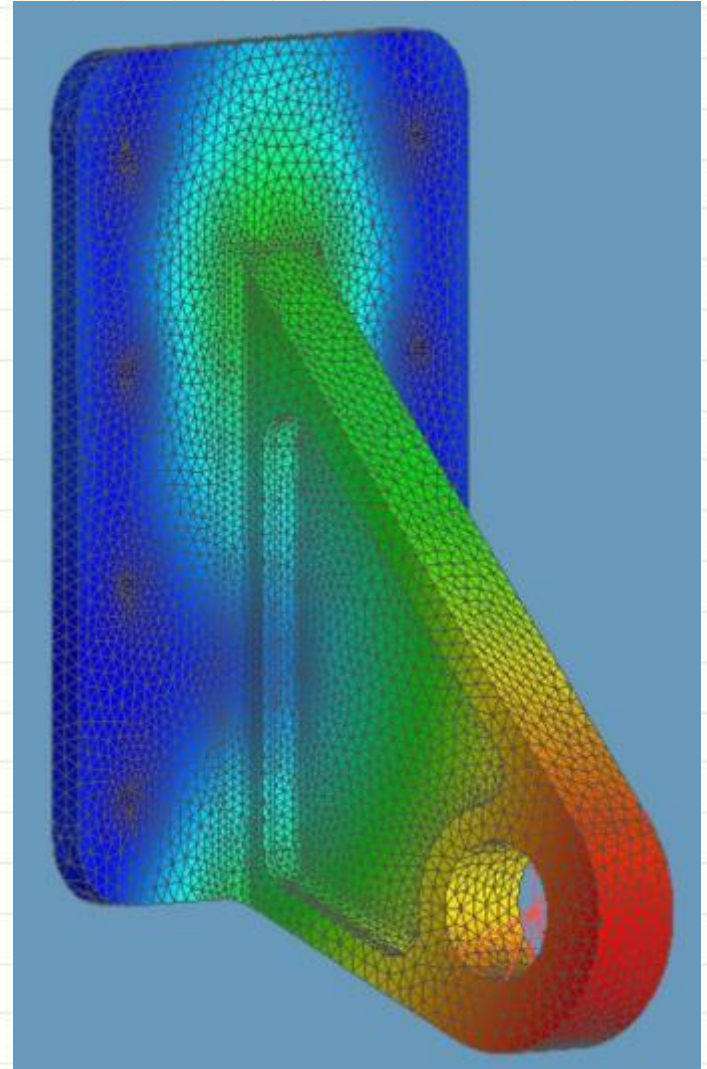2. Optimization

3. Graphical User Interface

Finite Element Analysis

Conceptually simple

- Map where the
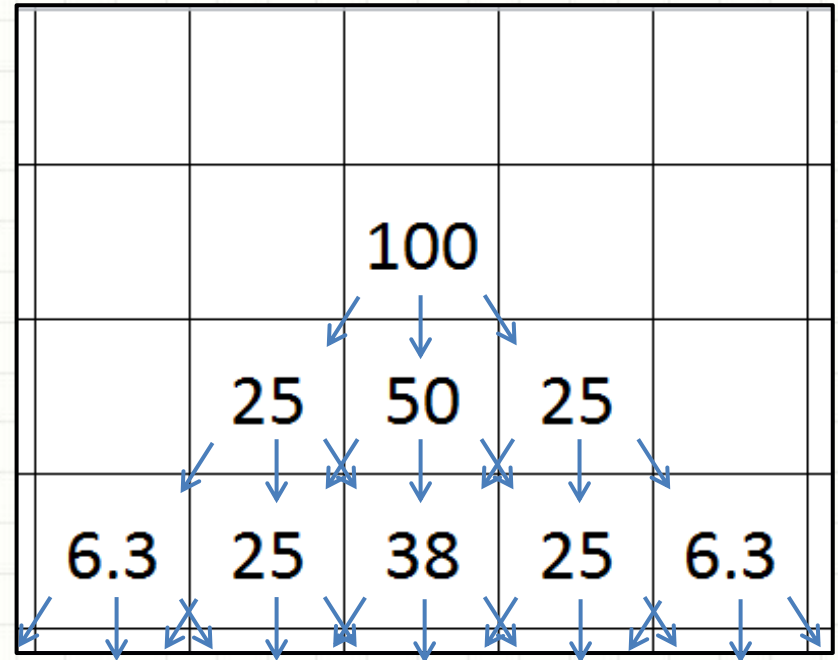   material will break
    first

 Difficult to calculate

- Each element depends
on other elements

FEA in SimpleOpt

Weights apply force

- Only one direction

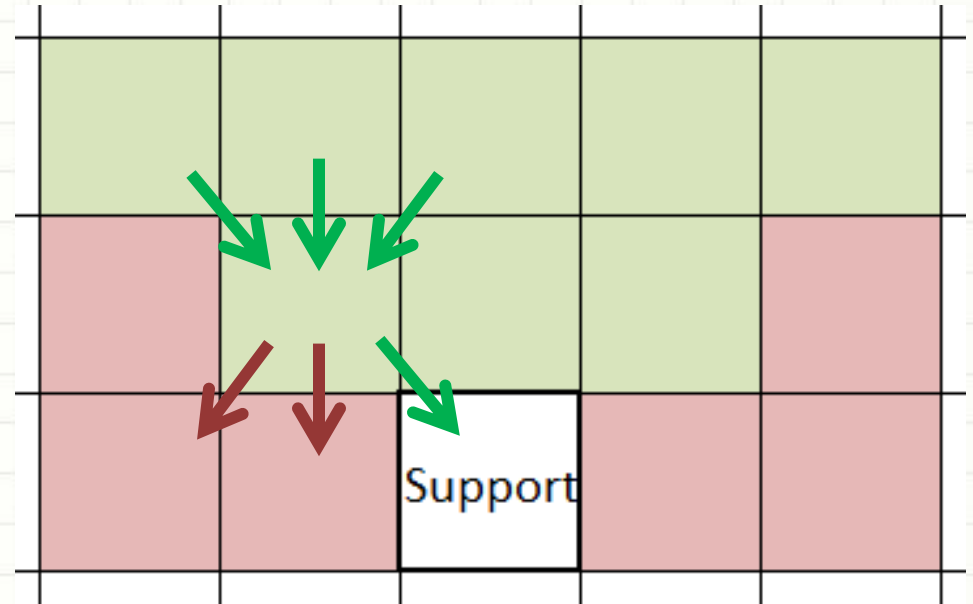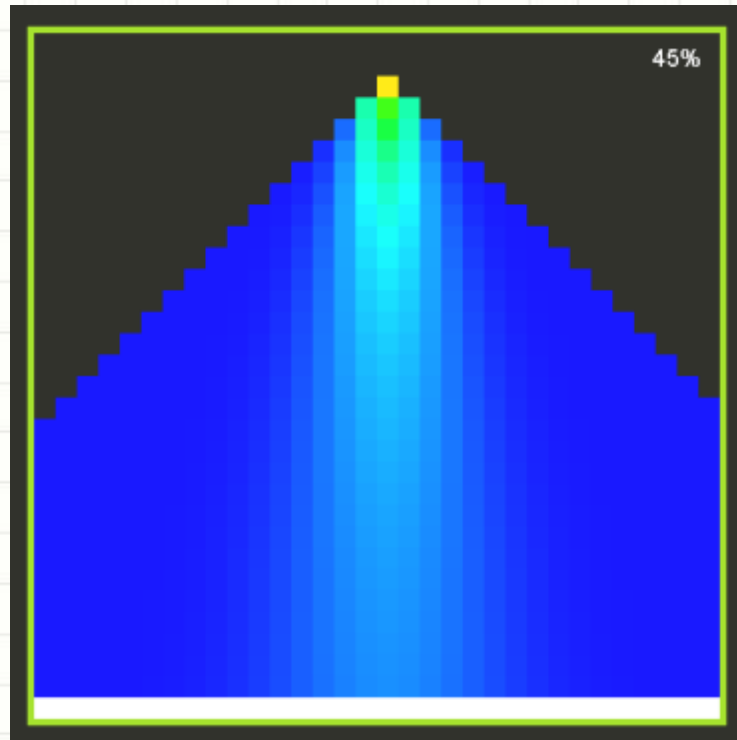- Divide stress between elements beneath

FEA in SimpleOpt

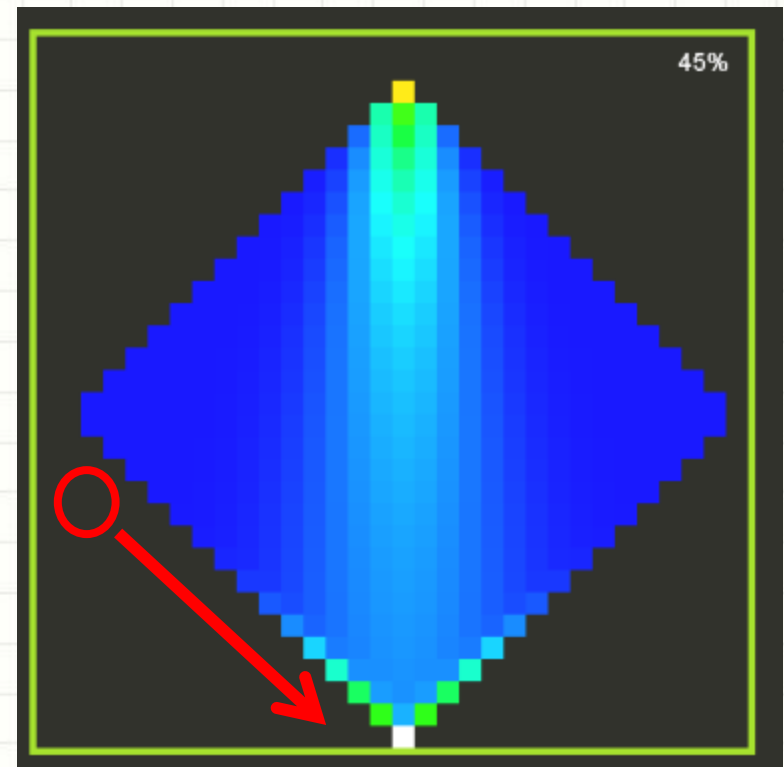Force is only applied to elements beneath element.

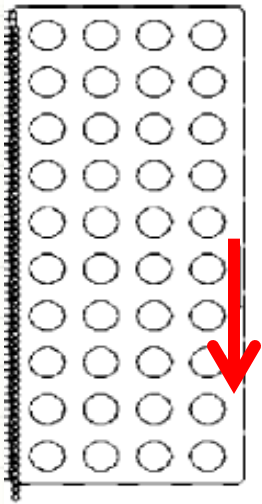- Causes creation of 45 degree angles in geometries

FEA in SimpleOpt

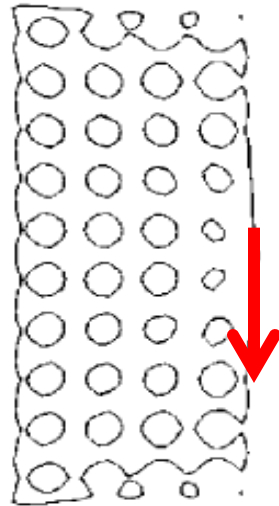
Only applies stress to supported elements

Optimization

(a) (b) (c)

(d) (e) (f)

Relatively Straightforward process
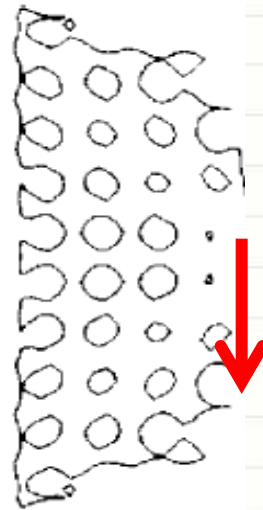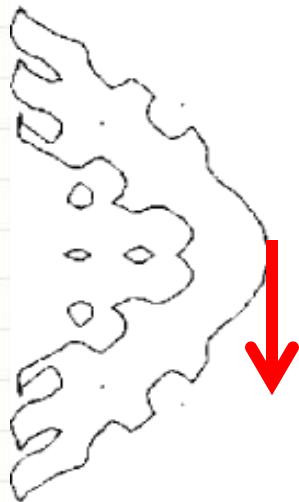1. FEA
2. Check base conditions
3. Remove/add
4. Repeat / be done!
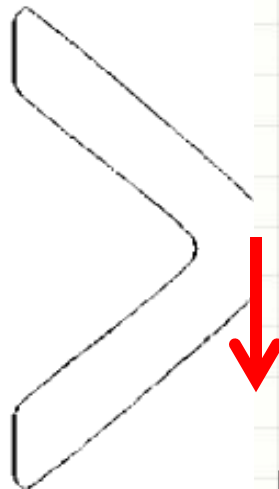
Level Set Method
(Wang *et all.*, 2003)

Graphical User Interface

- Makes other components usable
- Options for optimization

Project Goals

Topology Optimization is beneficial, but impractical
- Time
- Computationally demanding

Can the T.O. process be simplified to negate these problems?
- Two dimensions instead of three
- Swap *Toy Physics* for real physics

Was SimpleOpt Successful?

- Significantly faster

- Not very accurate

- Making SimpleOpt more accurate would increase accuracy, decrease speed

QUESTIONS?