Investigation of Multiple Hits on Light Armor

by

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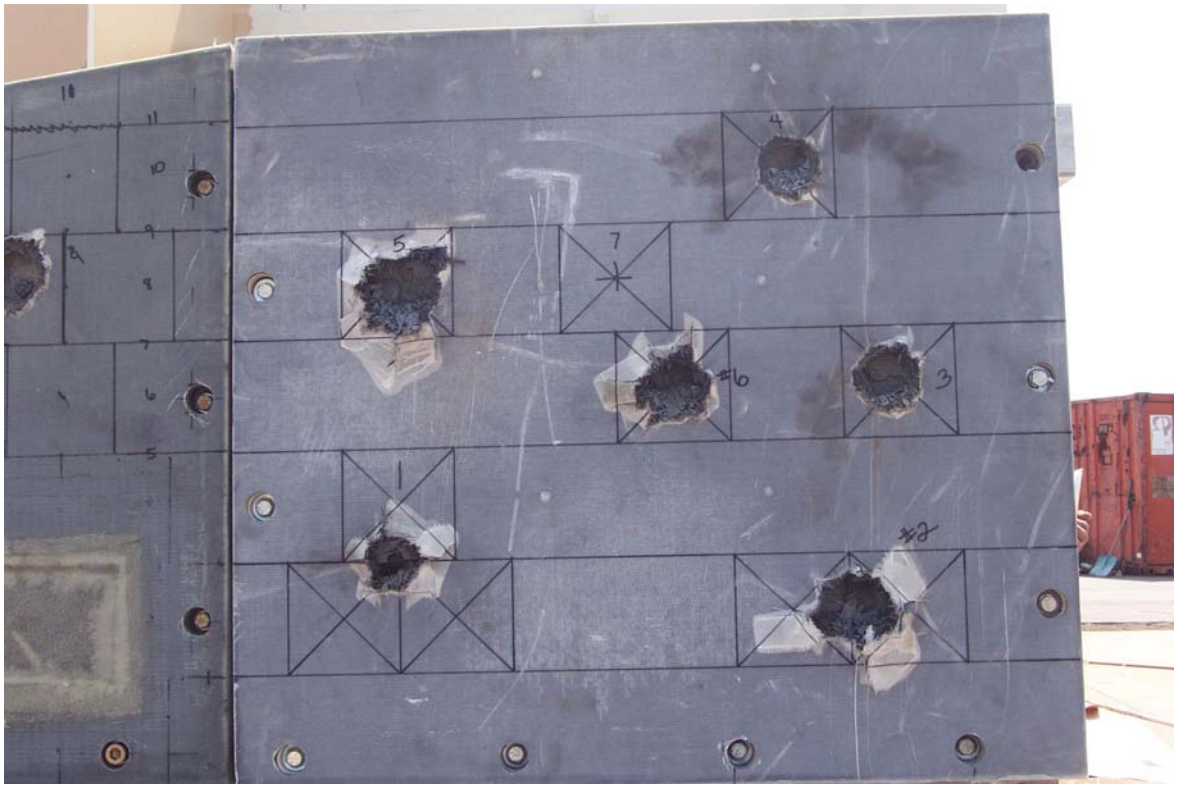
Outline

- Background/Motivation
- Definitions
- Assumptions
- Model Development
- Results
- Summary

Light Armor



Previous Work

- Two models developed to examine vulnerability of light armor to automatic weapons fire
- Probability of perforation was calculated using either a Monte Carlo method or a uniform random distribution of impact point locations
- Each approach had good and bad points

Motivation

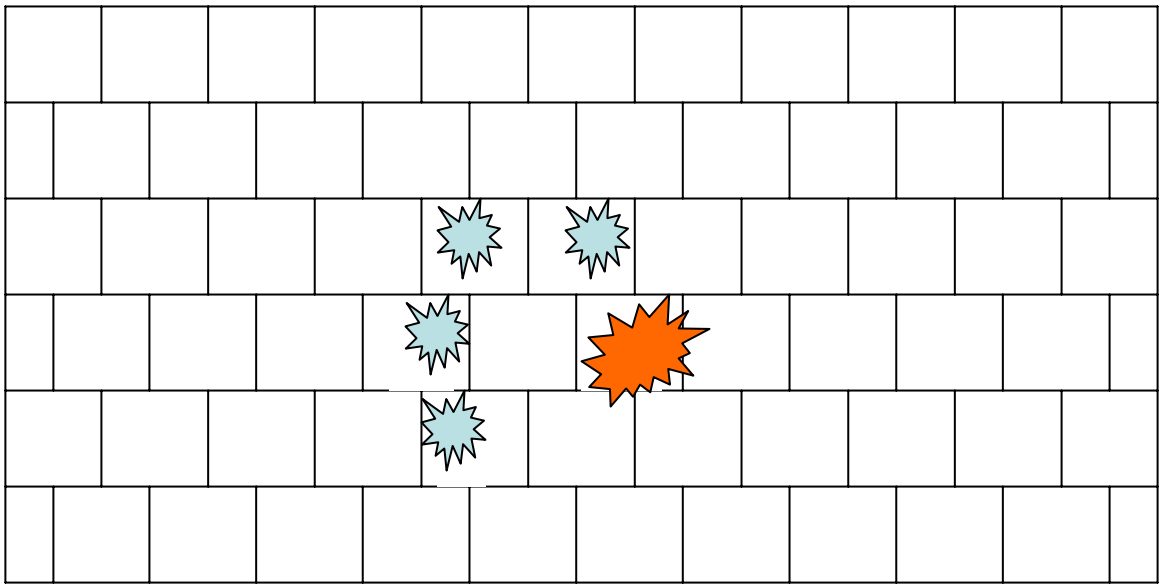
- Simple model gives reasonable results for large (>5) shots in a burst but poor answer for fewer shots
- A probable scenario would be a low shot number at close range (urban terrain)
- Opportunity was presented to draw upon West Point expertise to refine and enhance a correct model using Mathematica

Definitions

- Multi-Hit Capable
  - Tile adjacent to an impacted tile is capable of defeating a subsequent impact
  - Impacts at seams and triple points are defeated
- Multiple-Hit Criterion
  - Expression of armor performance against many impacts from automatic weapon fire
  - Related to possible battlefield situation

Impacts on Multi-Hit Capable Armor

(Idealized Tile Array)

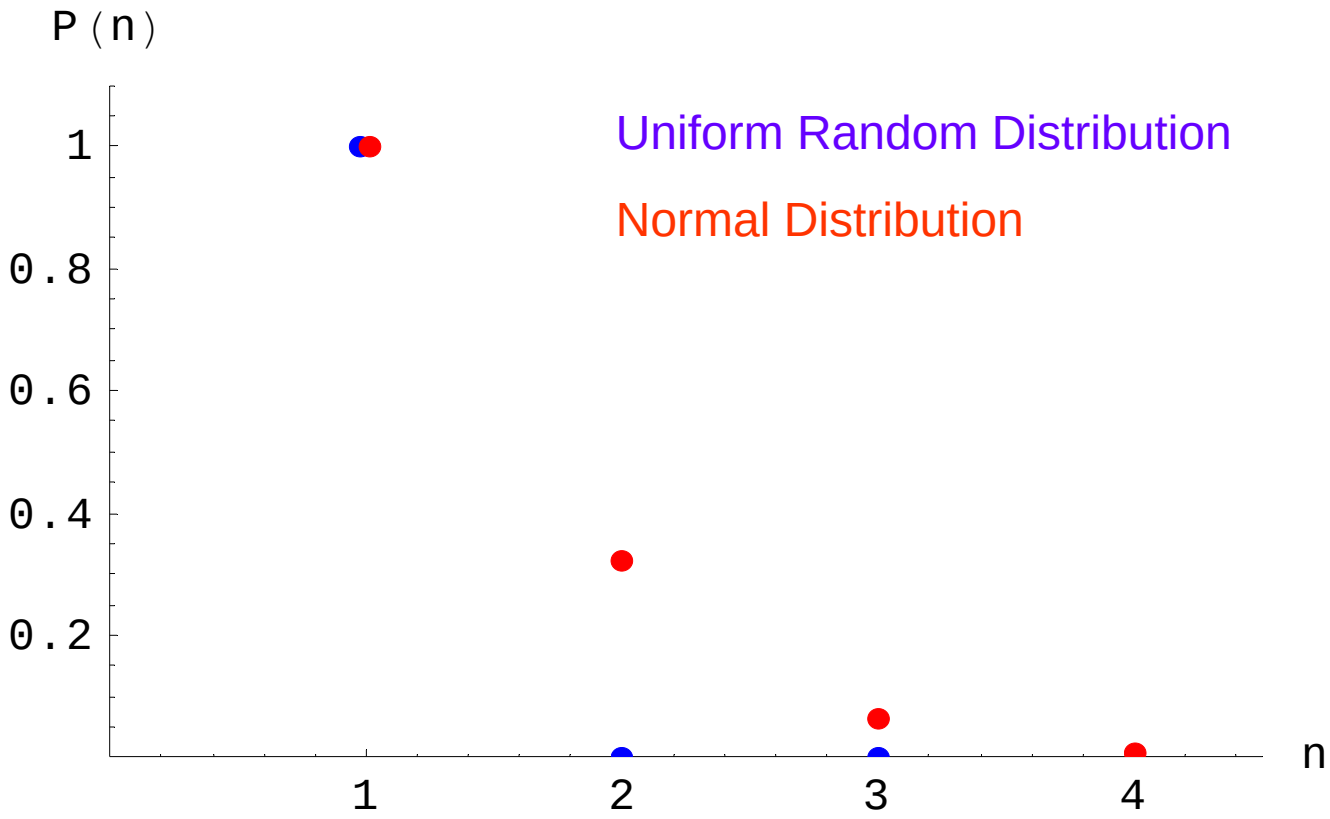


Assumptions

- Armor is multiple-hit capable
- Each tile can sustain one hit
- Low dispersion (normal distribution), few shots; stationary target
- Results are likely to be aim-point sensitive
- Probability of non-perforation is given by an average of results for 1000, 2000, and 3000 separate runs

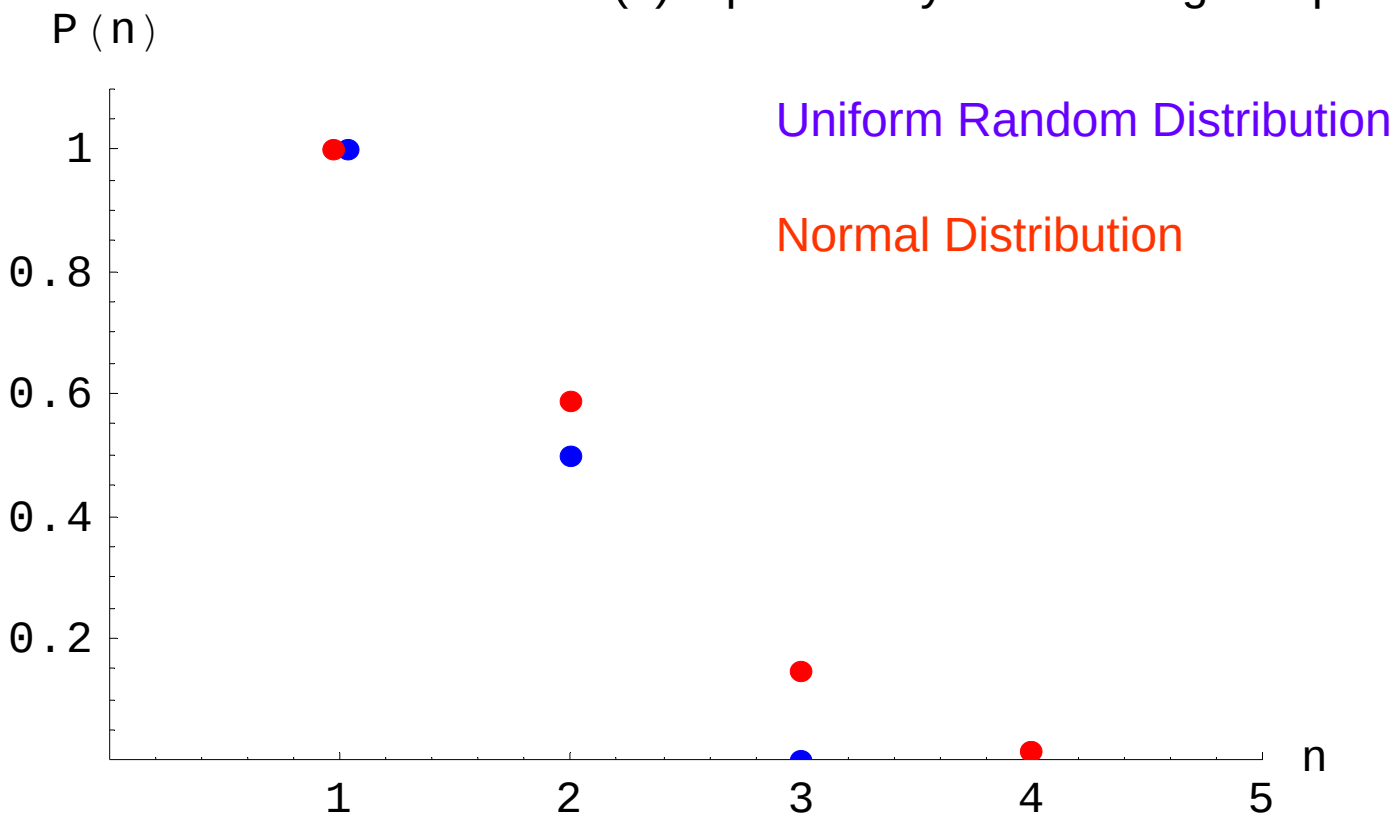
Tile Center Aim Point

P(n) = probability of defeating n impacts



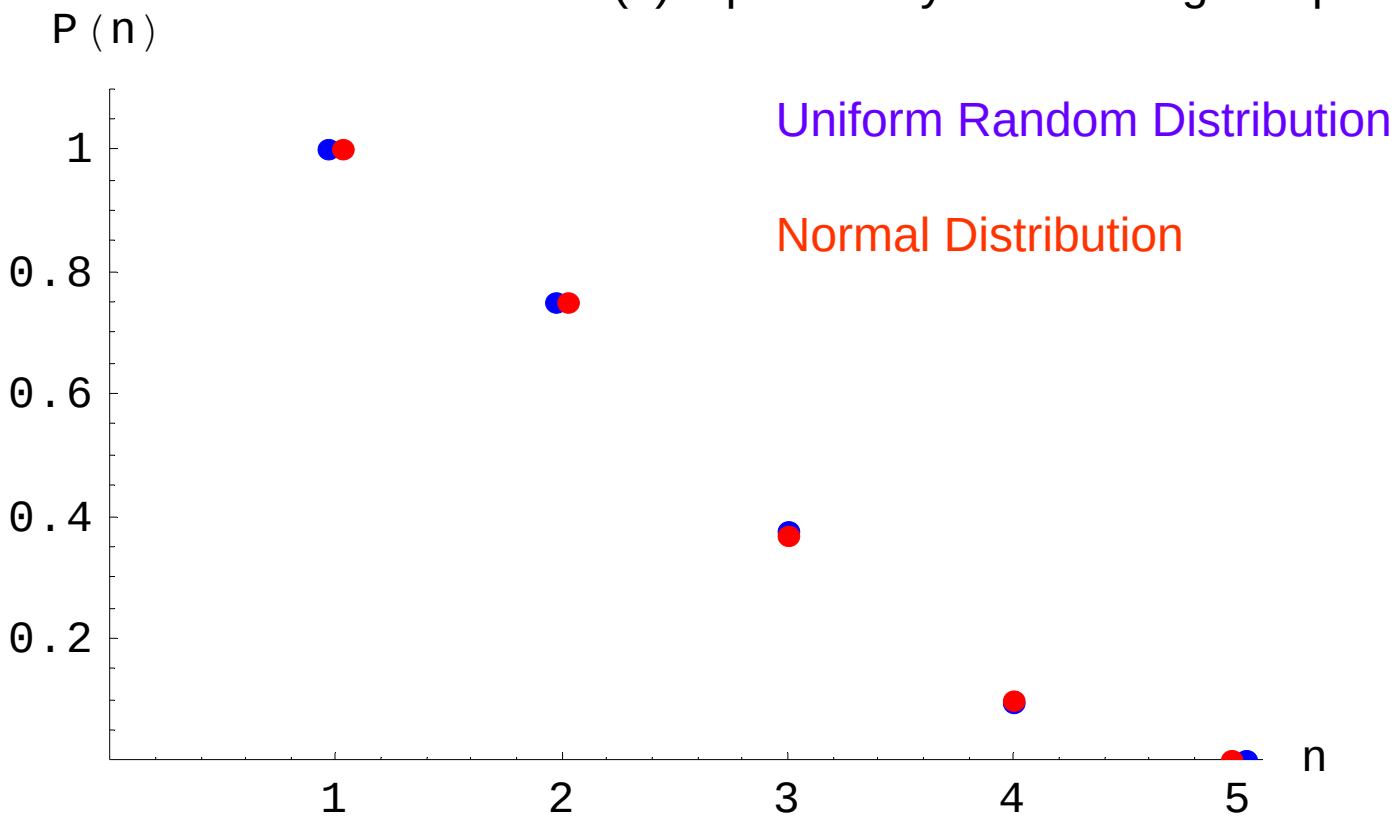
Seam Aim Point

P(n) = probability of defeating n impacts

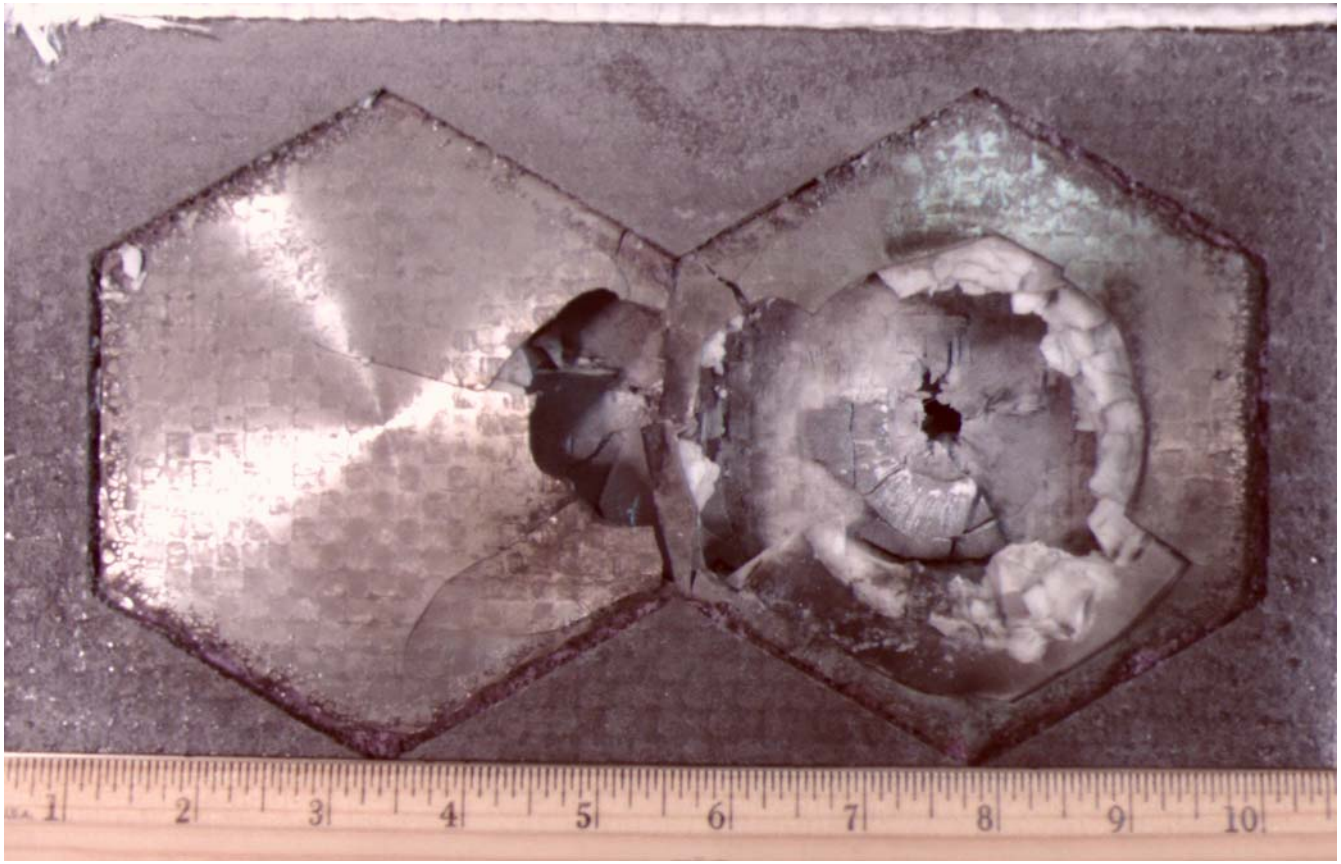


Quad Point Aim Point

P(n) = probability of defeating n impacts



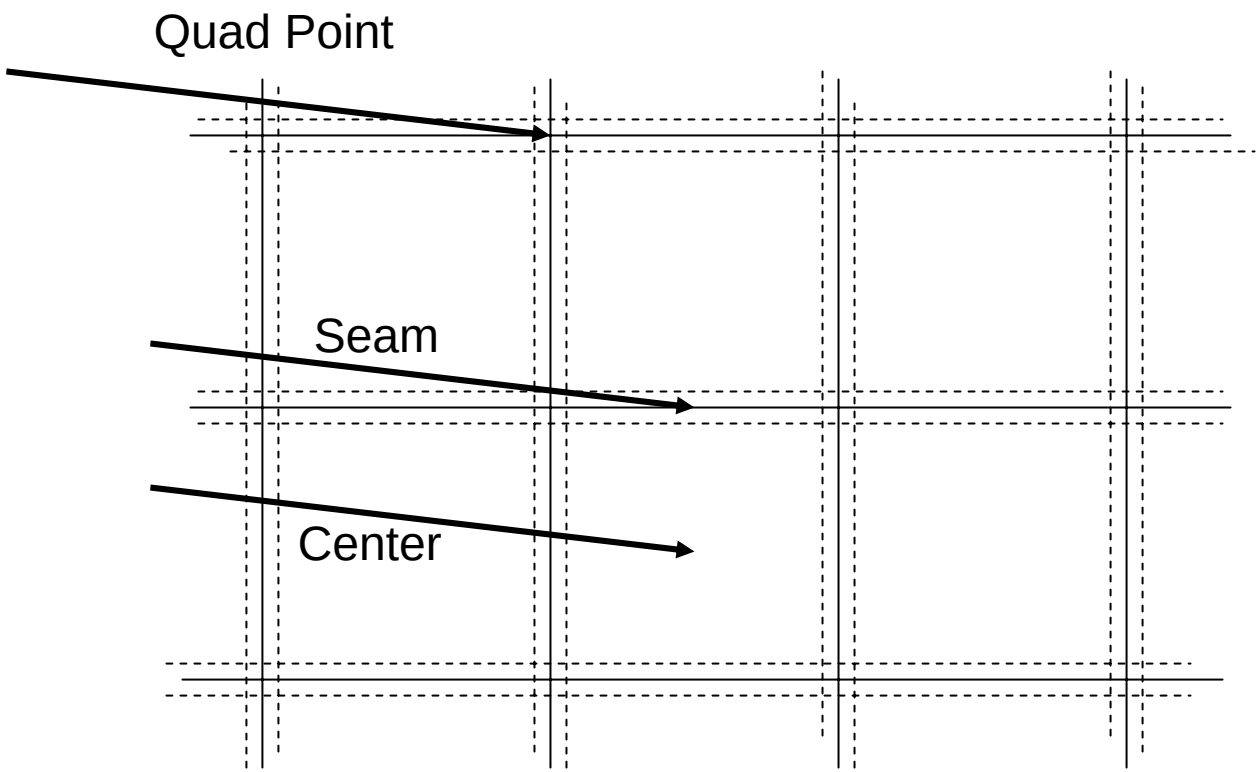
Two-Impact Experiment



1st Iteration Assumptions

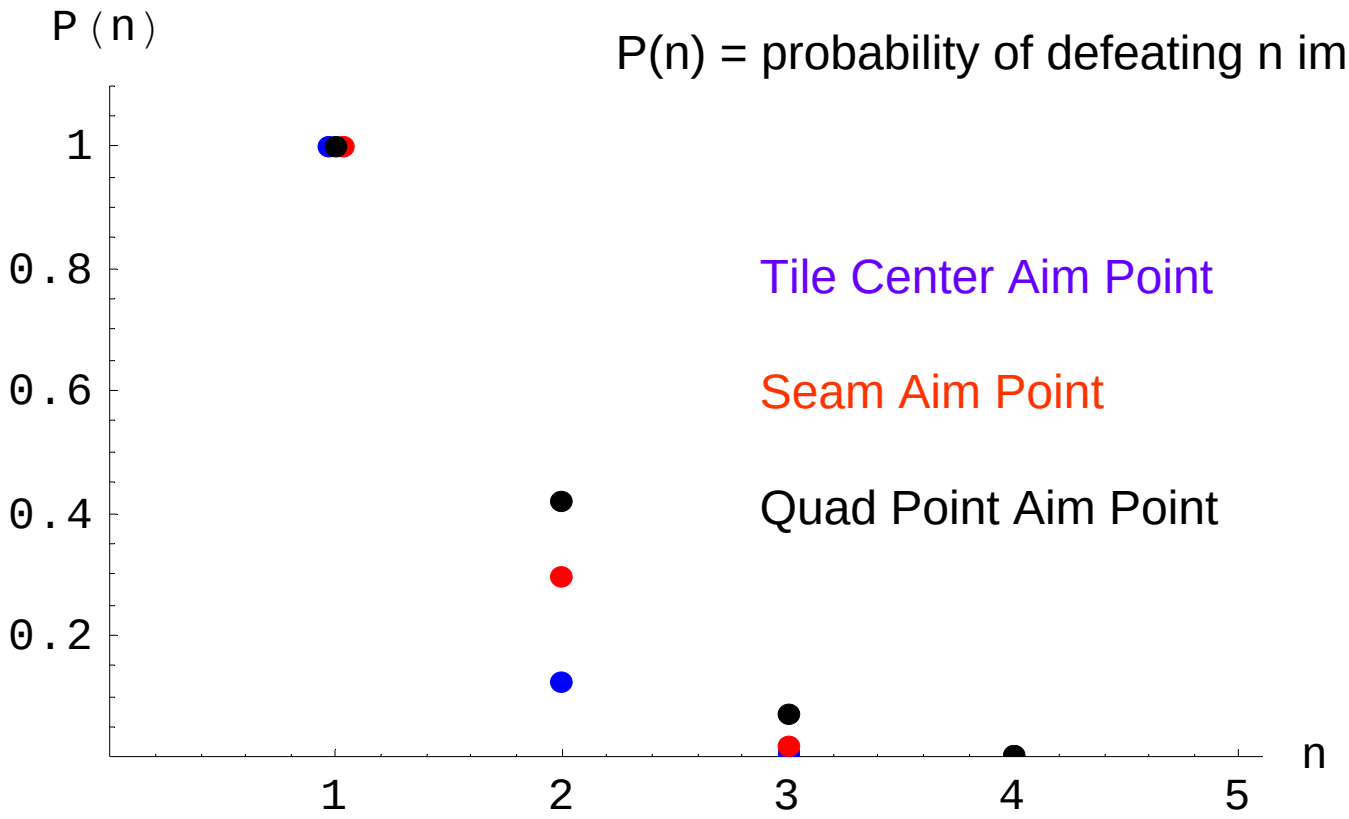
- Normal distribution of impacts
- Seam width is related to bullet diameter
- Seam hit results in two or more tiles being destroyed
- Bullet is defeated in seam
- Low dispersion of impact locations (short range); stationary target
- Results are likely to be aim-point sensitive

Aim Points



1st Iteration Results

P(n) = probability of defeating n impacts



Summary

- Uniform Random Hit Model underestimates armor performance in certain situations
- Mathematica provides a tool to investigate a wide variety of impact scenarios
- Probability of light armor defeating a small burst of automatic weapons fire at close range depends on aim point of weapon