Mathematics Behind Stronghold Calculation

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This document explains the mathematics behind the calculations used to determine the stronghold location based on directional throws in a 2D coordinate plane (x, z). The approach uses vector mathematics, trigonometric functions, and linear equations to find intersections and suggest next steps based on the player's input.

1. Vector Representation and Angle Conversion

In a 2D coordinate system, any point or direction can be represented as a vector. To determine the direction based on an angle (in degrees), we convert this angle into radians using the formula:

```
radians = angle * (PI / 180)
```

By converting to radians, trigonometric functions like sine and cosine can be used effectively. The x and z components of the directional vector are then:

```
x = sin(radians)
z = cos(radians)
```

This gives a unit vector pointing in the direction of the throw.

2. Intersection of Two Lines

To locate the stronghold, the intersection of two directional lines (based on player throws) is calculated. When two vectors and their starting points are known, the system of equations representing these lines can be solved.

The determinant (det) of these vectors helps identify if the lines are parallel:

```
det = (v2_x * v1_z) - (v1_x * v2_z)
```

If the determinant is zero, the lines are parallel, and no intersection exists. When it is not zero, it indicates the presence of an intersection, and the coordinates can be calculated using linear equations.

```
t = -(v2_z / det) * delta_x + (v2_x / det) * delta_z
s = -(v1_z / det) * delta_x + (v1_x / det) * delta_z
```

Where delta represents the difference between the initial positions of the two lines. The variables t and s are parameters that scale each vector to find the intersection point.

3. Divergence Check

The solution must ensure that the intersection is in front of both starting points, indicating that the lines are converging towards the stronghold. If either parameter (t or s) is negative, it indicates that the lines are diverging, meaning they intersect behind the initial points. In such cases, the solution is invalid.

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4. Suggesting the Next Direction

After the initial throw, another direction must be suggested to accurately determine the stronghold's location. The suggestion is based on shifting the coordinates further along the throw's direction and applying a perpendicular offset.

The calculations involve projecting the position 500 units along the throw direction and then applying a perpendicular shift of 250 units to create two potential points. The method selects the point that is farther away from the origin as it is more likely to give a clearer second angle.

5. Distance Calculation

To validate the positions and provide measurements, the Euclidean distance formula is applied:

```
distance = sqrt((dx)^2 + (dz)^2)
```

Where dx and dz are the differences in x and z coordinates between two points. This formula calculates the straight-line distance, helping to determine the proximity between two calculated points or between a throw's origin and the intersection.