An approach similar to the one that was used for the sphere and the paraboloid was used for the cylinder. An old approach that wasn’t as effective is shown below:

Derivation for solving where a 3d parametric line with line point  and direction , intersects a cylinder with radius , axis point , and direction .

Parametric equations for a line in 3D space, rewritten, the first two are the same equation:



Consider a point  on the cylinder surface:

A

B

Using vectors, note that . This is the equation that defines the cylinder, given that , , and  are defined with actual real values. This equation is the Pythagorean theorem used with the triangle where  is the hypotenuse and a line orthogonal to the axis is drawn from  to the axis.

By making point  and substituting it into the equation for the cylinder, you can solve for x, which will produce 2 values for x, provided that you have real values given for 