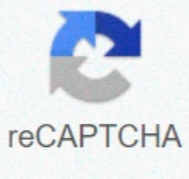




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# Line of intersection of two planes formula

How to calculate the line of intersection of two planes. How to find the line of intersection of two planes.

Solution: Since the equation of the plan and its normal,  $Ax + By + Cz + D = 0$  and  $N = Ai + Bj + Ck$  then,  $N1 = -3i + 2j - 3k$  and  $N2 = 2i - j - 4k$ . To write the equation of the intersection line, that is, we still need the coordinates of one of its  $P(x0, y0, z0)$  points. Let this point be the intersection of the intersection line and the  $xy$  coordinate plane. Then, the coordinates of the intersection point  $(x, y, 0)$  must meet the equations of the data plans. Therefore, by connecting  $z = 0$  in  $P1$  and  $P2$  we obtain, then, the intersection line is Using the same method we can control the validity of the equation obtained by calculating the coordinates of another intersection point of the intersection line and for example the  $yz$  coordinate plane, and connect them to the equation mentioned. Solution: Since the equation of the plan and its normal,  $Ax + By + Cz + D = 0$  and  $N = Ai + Bj + Ck$  then,  $N1 = -3i + 2j - 3k$  and  $N2 = 2i - j - 4k$ . To write the equation of the intersection line, that is, we still need the coordinates of one of its  $P(x0, y0, z0)$  points. Let this point be the coordinates of another intersection point of the intersection line and for example the  $yz$  coordinate plane, and connect them to the equation mentioned. While this problem has a great text book answer, as explained @walcher, I don't think it is very elegant. This is because, the solution depends on the choice of an arbitrary point, which lacks geometric insight. Ideally, we would like this point to have some meaning, such as being close to the planes, or line or etc. For this reason, I would like to remind you of a John Krumm solution, which remains unnoticed by many. Let me make a decision. compose the plane  $\mathbf{P} = (\mathbf{n}, \mathbf{p})$ . There are two  $\mathbf{P}_1$  and  $\mathbf{P}_2$  aircraft, for which we would like to calculate the intersection line. It is trivial to calculate the direction as the transversal product:  $\mathbf{d} = \mathbf{n}_1 \times \mathbf{n}_2$  If we also want the resulting  $\mathbf{p}$  point to be as close as possible to the  $\mathbf{p}_0$  chosen point, we may write a distance:

$$\mathbf{M} = \begin{pmatrix} 2 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \mathbf{x} + \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \end{pmatrix} = \mathbf{0}$$
  
This matrix can now be used in a system of linear equations to solve the unknown point,  $\mathbf{p}$ , as well as the Lagrange multipliers,  $\lambda, \mu$ .  
$$\mathbf{M} \mathbf{x} + \mathbf{b} = \mathbf{0}$$
  
useful to understand the configuration of the points or for different parameterizations. I think it's a pretty accurate approach that offers a simple and pleasant method, with geometrically interpretable results. I publish the MATLAB code on my blog. Your planes are equivalent to the linear system  $\begin{pmatrix} 1 & 2 & 3 \\ 1 & -1 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$  If normal vectors are non-zero and non-parallel, you can always perform line operations so that  $\begin{pmatrix} 1 & 2 & 3 \\ 0 & -5 & -2 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$  is in a column and  $\begin{pmatrix} 1 & 2 & 3 \\ 0 & -5 & -2 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$  is in another. Then you can choose an arbitrary value for the variable corresponding to the third column and determine the corresponding values for the other two. Choosing  $z=0$  gives  $(1, 0, 0)$ . Choosing  $z=3$  gives  $(-4, -2, 3)$ . We will now add the equations together:  $(2x+x) + (y-y) = 3+3 \implies 3x+0 = 6 \implies x=2$  Plugging  $x=2$  back into  $2x-y=3 \implies y=1$ . Putting these values together, the point on the intersection line is  $(2, 1, 0) = 2\mathbf{i} + \mathbf{j}$ .  
The vector equation for the intersection line is given by  $\mathbf{r} = \mathbf{R} + t\mathbf{V}$  Where  $\mathbf{R}$  is a point on the line and  $\mathbf{V}$  is the result of the transversal product of the normal vectors of the two aircraft. The symmetrical equations for the intersection line dates by  $\frac{x-2}{1} = \frac{y-1}{1} = \frac{z-0}{0}$  Where  $A(2, 1, 0)$  are the coordinates from a point on the intersection line and  $V(1, 1, 0)$  come from the transversal product of normal vectors to the indicated floors. Example finds the parametric equations for the intersection line of the plans  $2x + y - z = 3$  and  $x - 3y + z = 3$ . We need to find the vector equation of the intersection line. To get it, we will first need to find  $\mathbf{V}$ , the transversal product of normal carriers of data plans. The normal vectors for planes are  $\mathbf{n}_1 = (2, 1, -1)$  and  $\mathbf{n}_2 = (1, -3, 1)$ .  
$$\mathbf{V} = \mathbf{n}_1 \times \mathbf{n}_2 = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 2 & 1 & -1 \\ 1 & -3 & 1 \end{vmatrix} = \mathbf{i}(1 \cdot 1 - (-1) \cdot (-3)) - \mathbf{j}(2 \cdot 1 - (-1) \cdot 1) + \mathbf{k}(2 \cdot (-3) - 1 \cdot 1) = \mathbf{i}(1 - 3) - \mathbf{j}(2 + 1) + \mathbf{k}(-6 - 1) = -2\mathbf{i} - 3\mathbf{j} - 7\mathbf{k}$$
  
Now we will add the equations together:  $(2x+x) + (y-y) = 3+3 \implies 3x+0 = 6 \implies x=2$ . Connect  $x=2$  to  $x-y=3$ , we get  $2-y=3 \implies y=-1$ . To find symmetrical equations, you will need the transversal product of normal two-storey carriers, as well as a point on the intersection line putting together these values, the point on the intersection line is  $(2, -1, 0) = 2\mathbf{i} - \mathbf{j}$ .  
Remember, since the direction number for  $\mathbf{X}$  from the transversal product  $\mathbf{V} = \mathbf{n}_1 \times \mathbf{n}_2 = (-2, -3, -7)$  is 0, we must pull the symmetrical equation for  $\mathbf{X}$  away from the other two and keep it alone so that we must not divide for 0.

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