Distance between point and plane vectors

The distance between a plane and a point It can sometimes be important to find the distance $D$, between some point $P_0$ and a plane in the form $ax + by + cz + d to 0$. The formula for the distance between a $-Pi plane: ax + by + cz + d a 0$ and a point is $P(x_0, y_0, z_0)$ is as follows: (1) (1) begin (begin) (begin) (begin) (begin) (begin) (begin) (begin) (begin) (begin) (begin) (begin) (begin) (begin) (begin) (begin) (begin) (begin) (begin)) (begin) (begin) and D (align D) is as follows: (1) start (begin) d-2 + c-2 + c-2-ax_0 + by_0 + cz_0 + d (mid-category) is 2 + b2 + c.2 + end (end) and now we'll go out and try this formula. Theorem 1: Let $-Pi$ be a plane at $-mathbb-R-3$ and $P_0(x_0, y_0, z_0)$ is a point at $-mathbb-R-3$. Then the distance $D$ between $-Pi$ and $P_0$ is given by $D from the $D to the average ax_0 + by_0 + cz_0 + d mid-unit, sqrt, 2, b2 + c2, 2 , $. Test: Let $Q(x_1, y_1, z_1)$ be any point on the $-Pi$ aircraft and let $P_0 (x_0, y_0, z_0)$ be our point of interest. Let $-vec-QP_0- (x_0 - x_1, y_0 - y_1, z_0 - z_1)$. Remember that this plane can be defined with a vector perpendicular to the plane known as normal. Let the $n (a, b, c)$ normal for our $-Pi$ aircraft. The orthogonal projection of $-vec-QP_0$in $-vec-n-$ is equal to the distance between the plane $-Pi$ and $P_0$ as illustrated below: Thus it follows that $D . . . . mathrm.proj.proj.QP_{0}-- When you simplify and leave $d -ax_1 - by_1 - cz_1$ we get: (2) .begin -align- D - .mathrm,proj, vec, á, QP_{0}, in the application field, the QP_{0}. D á á frac- á vec-QP_0- .cdot .vec.n. • . . . . D á á frac- á medium (x_0 - x_1, y_0 - y_1, z_0 - z_1) b, c) mid-page of the unit a2 + a2 + c2 + c2 , D, frac and x_0- - x_1) + b(y_0 - y_1) + c(z_0 - z_1) ? mid -sqrt,a, 2 + b, 2 + c, 2, D, D, ax_0 + by_0 + cz_0 + d á mid-sqrt-a-2 + b-2 + c-2-á - blacksquare -end-align- What is the distance between the distance between point $P(1, 2, 3)$ and the plane $-Pi: 2x + 2y -3z +3o 0$? We can answer this question by directly applying our formula in such a way that we get: (3) a-start-align-D-2-2(1) + 2(2) -3(3) + 3 in the middle of the unit, 2, 2 , 2 , 2 + (2) + (2) + (2 3) 2, D, D, frac and mid- - mid, sqrt{17} and D (frac 2 , sqrt{17} end $P) -12)$ and the plane $-Pi : 4x - 8y -3z + 5 x 0$? Again, we can apply the formula to get the answer. (4) 'start'align'D''sqrt,16 + 64 + 9{89}, D, frac and mid 89 (medium 89) and sqrt{89} ({89} A) is the distance between a given point and its orthogonal projection on the nearest plane or point plane. It can be found starting with a variable change that moves the origin to match the given point and then find the point on the moved plane to x + b and + c z á displaystyle ax+by+cz-d which is closer to the origin. The resulting point has Cartesian coordinates (x , y , z)) : x a d a 2 + b 2 + c 2 , and á b d a 2 + b 2 + c 2 , z á c d a 2 + b 2 + c 2 ? displaystyle x 'displaystyle x 'ad'{2}+b-{2}+c-{2},quad ,quad ,displaystyle y-frac -bd-{2}+b-{2}+c-{2},quad ,quad , z, frac and {2}+b{2}+c{2}. The distance between the origin and the point (x , y , z), the display style (x,y,z) is x 2 + and 2 + z 2 , display style, sqrt, x, {2} + y, {2} + z, {2}, . Converting the general problem to the distance problem from the source Suppose we want to find the nearest point on a plane to the point (X 0 , Y 0 , Z 0 , X_{0}, Y_{0}, Z_{0}), where the plane is given by an X + b Y + c Z - D . We define x to X x X 0 to the display style x x X-X_{0} , y - Y - Y 0 - displaystyle y -Y-Y_{0} , z - Z - Z 0 - displaystyle z - Z-Z_{0} , y d - a X á X á X á X á0 a b Y 0 to c Z 0 a displaystyle d-D-aX_{0}-bY_{0}-cZ_{0}, to get an x + b y + c z á d displaystyle ax+by+cz-d as the plane expressed in terms of the transformed variables. Now the problem has become one of finding the closest point on this plane to the origin, and its distance from the origin. The point in the plane in terms of the original coordinates can be found from this point using the previous relationships between x .displaystyle x and X -displaystyle X , between y -displaystyle y y Y -displaystyle Y -displaystyle Y -displaystyle Y between z-displaystyle z- and Z -displaystyle Z- ; the distance in terms of the original coordinates is the same as the distance in terms of the revised coordinates. Highlighted by linear algebra The formula for the point closest to the origin can be expressed more succinctly using linear algebra notation. The expression a x + b y + c z z - displaystyle ax+by+cz in the definition of a plane is a point product (a , b , c) · (x , y , z) (x,y,z), and the expression at 2 + b 2 + c 2 a displaystyle a-{2}+b-{2}+c-{2} that appears in the solution is the squared standard. (a , b , c) 2 -display style ((a,b,c) {2} . Therefore, if v á (a , b , b , c) á displaystyle ,mathbf á (a,b,c) is a given vector, the plane can be described as the set of vectors w .displaystyle .math ·bf . V? 2 'displaystyle ''mathbf''''''frac'''mathbf''''''''''''''''''''{2}'' [1][2] Euclidean distance from origin to plane is the norm of this point, d? V? = | 2 + b 2 + c 2 ? •Mathbf (Mathbf) (mathbf) •frac-d-d---- sqrt {2}+b-{2}+c-{2}. . Because this is the closest point in coordinate or vector formulations, you can verify that the given point is on the given plane by connecting the point in the plane equation. To see that it is the point closest to the origin on the plane, notice that p The value of vector v is a scalar multiple that defines the plane and is therefore orthogonal to the plane. So, if q 'displaystyle 'mathbf 'q' is any point on the plane other than p 'displaystyle 'mathbf 'p' itself, then the line segments from the origin to the origin at p . . . . Q? 2 + ? q q q q q 2 'display style ''''''''''''''''''''''{2}''' Since then, q á q q 2 The display style of the image of the {2} image unit display unit must be a positive number, this distance is greater than that of the unit page of the unit , this distance is greater than that of the unit class of the unit, this distance is greater than that of the unit class of the unit of the unit of the unit, this distance is greater than that of the class. Q? •Displaystyle (Displaystyle) (displaystyle) (displaystyle) (displaystyle) (displaystyle) (displaystyle), the distance from the source to the p . [2] Alternatively, it is possible to rewrite the plane equation using point products with p .displaystyle .mathbf -p - instead of the original point product with v .displaystyle .mathbf -v - (because these two vectors are scalar multiples of each other) after which the fact that p .displaystyle .mathbf -p - is the closest point becomes an immediate consequence of the Cauchy-Schwarz. [1] Nearest point and distance for a hyperplane and an arbitrary point The vector equation for a hyperplane in n.o-displaystyle n-dimensional Euclidean space R n -displaystyle .mathbb ?mathbb ≠ - R - The {0} of eq is (x a p) · a á a 0 á displaystyle ('mathbf 'x''''mathbf ''''''''''''''''''''''''''''·''x''''''''''''''''''''''''''''''''' · a value of type displaystyle d, mathbf and s (, [3] The corresponding Cartesian shape is a Cartesian shape of 1 x 1 + a 2 x 2 + ⋯ + to n x n á d á displaystyle a_{1}x_{1}+a_{2}x_{2}+-cdots +a_-n-x_-n-d- where d á p &lt;1&gt; p · p &lt;5&gt; a a a a at 1 p 1 + to 2 p 2 + ⋯ a n p n .displaystyle d.mathbf.p.s.s.b.m.a.m.a.m.a.o.a_{1}p_{1}+a_{2}p_{2}+-cdots a_.n.p_.n. The closest point of this hyperplane to an arbitrary point and the display style of the life expression is x a y (y á p) · a · a] a a á and a [and · a a a · a] a á from the image screen of the image image of the image of the unit image of the image unit of the image of the image The unit of the image unit image unit of the image unit of the image unit of the image unit of the unit of the image of the unit of the image unit of the image unit of the image unit of the image unit of the image unit of the unit of the image of the unit of the image of the unit of the image of the unit of the image unit image unit image unit of the image unit of the image unit of the image unit of the image unit of the image unit of the image unit of the image unit of the image unit of the image unit of the image unit of the image unit of the unit of the image of the unit of the image unit image unit image unit of the image unit of the image unit of the image unit of the image unit of the image unit of the image unit of the image unit of the image unit of the mathbf image unit ,p) , cdot , mathbf , mathbf (mathbf), mathbf (mathbf) ,p (, mathbf), mathbf (, left (, dfrac) (, mathbf) (, ,,'' the distance from the hyperplane is of display style and from the ‖ x to y ‖ ‖ [(y á p) · a · a] to ‖ a á . (and a p) · a ‖ a ‖ of the house of the ‖ of the house of ‖ and · a a á d á ‖ a ‖ of the left ,mathbf , x , Mathbf , y , on the right, left, left, a (mathbf, mathbf -y, mathbf, mathbf (mathbf mathbf)) and -Mathbf -mathbf (mathbf)-cdot -mathbf (mathbf (•Left-mathbf-a-right-right-right-right-right-right-right-right-right-right-right-.- -dfrac -left-mathbf -y- ,cdot, mathbf -d, right •Left-mathbf-right-right-right-right-right-right-right-right-right-right-right-.- . [3] Written in Cartesian form, the nearest point is given by x i - y i á k a i - displaystyle x_-i-y_-i-ka_-i for 1 ≤ i ≤ n .display 1.leq i-leq-leq-leq-leq-i-i-i-i-i-i-1 ≤ i ≤ n .-displaystyle 1-leq i-leq-leq n. where k á and · a a a a · to 1 and 1 + a 2 and 2 + ⋯ to n and n to 1 2 + 2 2 + ⋯ to n 2 s.a. . dfrac ?mathbf ?y- ?cdot ?mathbf 'a- d'mathbf''a'cdot'mathbf''''''mathbf''''''''a_{1}y_{1}''''''''''a_ a_{2}y_{2}'''y_''-n-d-a_{1}-{2}+a_{2}-{2}+-cdots a_-n-{2}, and the distance from y - displaystyle , mathbf , and , to which the hyperplane is the server of the text unit, and the distance from y , displaystyle , mathbf to the hyperplane , is from the unit unit unit unit unit unit of the unit unit unit of the unit Unit unit unit unit unit unit from unit unit unit unit unit unit from unit to 1 and 1 + 1 + to 2 + 2 + ⋯ to n and n a d to 1 2 + to 2 2 + ⋯ n 2 2 , display style , dfrac , a_{1}y_{1} + a_{2}y_{2} + , cdots a_, n, y_, n, d, right, right, left, a_{2}y_{2} + to cdots a_. •sqrt a_{1} {2}+a_{2}-{2}+-cdots a_-n-{2}- . Therefore, in R 3 , in the display style of the {3} screen, the point of a plane a x + b and + c z á d displaystyle ax+by+cz-d closest to an arbitrary point (x 1 , y 1 , z 1) (x_{1}.y_{1},z_{1}) is (x , y , z), the display style (x ,y,z) given by x x x 1 a k a y a y 1 á k b z á z 1 á k c á . begin, array (begin) ,array (begin) (array) (begin) (array) (begin) (begin) (array) (begin) (array) (begin) (array) (begin) (array) (begin) (array) (begin) (array) (begin) (array) (begin) (begin) (begin) (begin) (begin) (begin) (, matrix (, z_{1} y_{1} x_{1} 3) and 3, 2 + c 2 s-displaystyle k-dfrac -ax_{1}+by_{1}+cz_{1}-d-{2}+b-{2}+c-{2}, and the distance from point to plane is of the property . a x 1 + b and 1 + c z 1 á á a a a a a a a 2 + b 2 + c 2 adacc -dfrac -left-ax_{1}+by_{1}+cz_{1}-d-right- sqrt {2}+b-{2}+c-{2}. . See also Distance from a point to a normal Hesse line shape mow lines , Distance references , a b Strangle, Gilbert; Kai (1997), Linear Algebra, Geodesy, y GPS, SIAM, págs. 22–23, ISBN 9780961408862. A b Shifrin, Ted; Adams, Malcolm (2010), Linear Algebra: A Geometric Approach (2a ed.), Macmillan, p. 32, ISBN 9781429215213. A b c Cheney, Ward; Kincaid, David (2010). Algebra Lineal: Teoría y Aplicaciones. Jones &amp; Bartlett Publishers. págs. 450, 451. ISBN 9781449613525. Obtenido de

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