

[Vector Controller](#)

[Scalar Output](#)

[Example:](#)

[Vector Output](#)

[Example:](#)

[Matrix Output](#)

[Boolean Output](#)



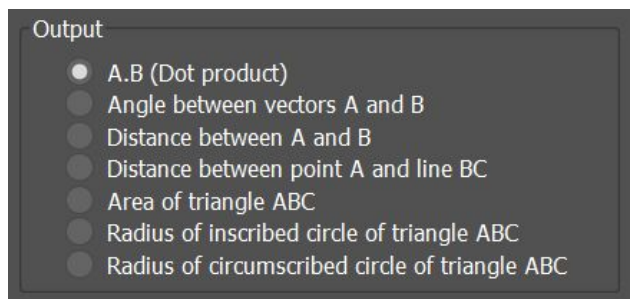
Vector Controller

Vector controller performs vector operations on one or between two or three input vectors. Note the vector controller always receives vector input in single format. The output could be either of the following 4 types:

Scalar Output

Following options are available when controller output is scalar:

- **A.B (Dot product):**Returns the [dot product](#) of the vector A and B.
- **Angle between A and B:** Returns the angle between vector A and B in degree. The result is always between 0 to 180.
- **Distance between point A and B:** Returns the distance between point A and B.
- **Distance between point A and line BC:** Returns the distance between point A and an infinite line which passes through points B and C
- **Area of the triangle ABC:** Returns the area of a triangle which connects points A, B and C

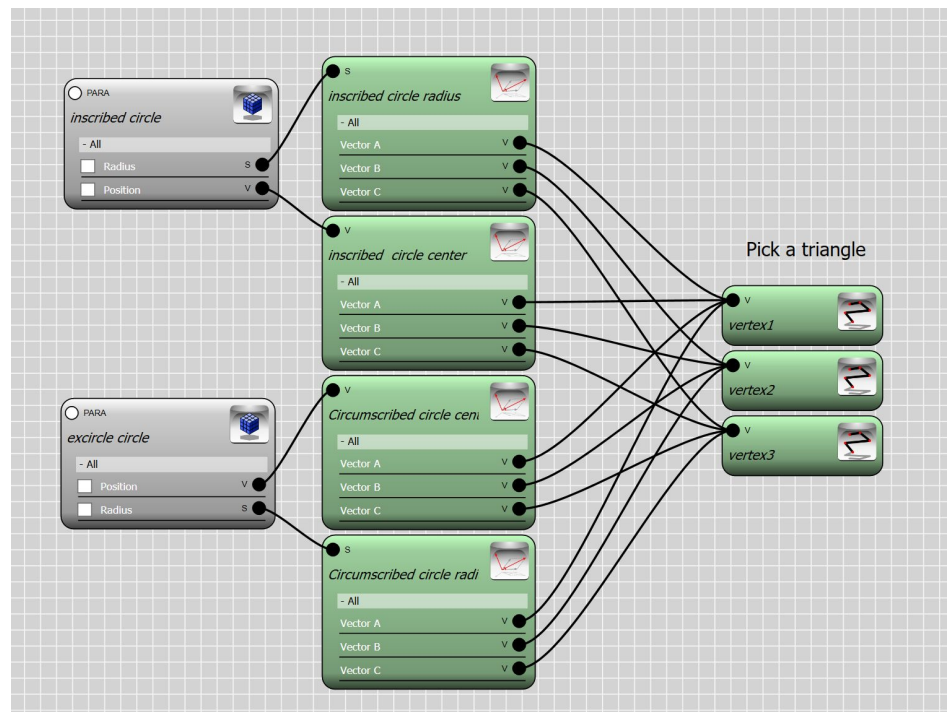
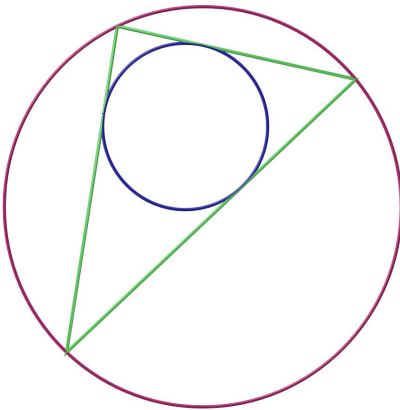


, if A, B and C are collinear the result is close to zero.

- **Radius of inscribed circle of triangle ABC:** Return the radius of the circle which is contained in the triangle and touches all 3 edges.
- **Radius of Circumscribed circle of triangle ABC:** Return the radius of the circle which passes through all three points A, B and C.

Example:

Open the Para3D\Examples\VectorController\inscribed and excircle circle of triangle.para



Vector Output

The following outputs are available in vector format

- **A+B** Return the result of vector addition
- **A-B** Return the result of vector subtraction, If A and B are considered as position vectors then A-B is a vector at B pointing to A.
- **A*B (Cross product)** Return the [cross product](#) of the vectors A and B.
- **Point between A and B:** Return the point in the middle of two points A and B. or $(A+B)/2$
- **Normalize A** Return a vector in unit length in direction of vector A.

Output

- A+B
- A-B
- A*B (Cross product)
- Point between A and B
- Normalize A
- Center of inscribed circle of triangle ABC
- Circumscribed center of triangle ABC
- Map vector A from Spherical to Cartesian coord-sys
- Map vector A from Cylindrical to Cartesian coord-sys
- Map vector A from Cartesian to Spherical coord-sys
- Map vector A from Cartesian to Cylindrical coord-sys

- **Center of inscribed circle of triangle ABC:** Return the center of the circle which is contained in the triangle and touches all 3 edges.
- **Circumscribed center of triangle ABC:** Return the center of the circle which passes through all three points A,B and C
- **Map vector A from Spherical to Cartesian coord-sys :** converts the coordinates of the point A from spherical (r,θ, φ) from to cartesian (x,y,z) using below formula :

$$\begin{aligned}x &= r \sin \theta \cos \varphi, \\y &= r \sin \theta \sin \varphi, \\z &= r \cos \theta.\end{aligned}$$

- **Map vector A from Cylindrical to cartesian coord-sys :** converts the coordinates of the point A from cylindrical (ρ,φ,z) from to cartesian (x,y,z) using below formula :

$$\begin{aligned}x &= \rho \cos \varphi \\y &= \rho \sin \varphi \\z &= z\end{aligned}$$

- **Map vector A from Cartesian to Spherical coord-sys :** converts the coordinates of the point A from cartesian (x,y,z) to spherical (r,θ, φ) using below formula :

$$\begin{aligned}r &= \sqrt{x^2 + y^2 + z^2}, \\ \varphi &= \arctan \frac{y}{x}, \\ \theta &= \arccos \frac{z}{\sqrt{x^2 + y^2 + z^2}} = \arccos \frac{z}{r} = \arctan \frac{\sqrt{x^2 + y^2}}{z}.\end{aligned}$$

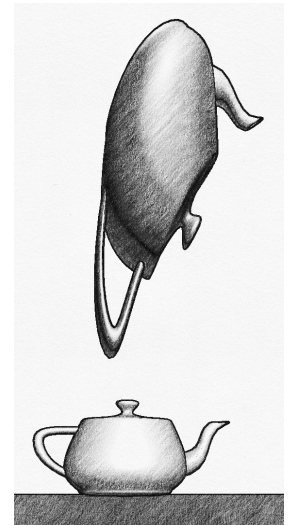
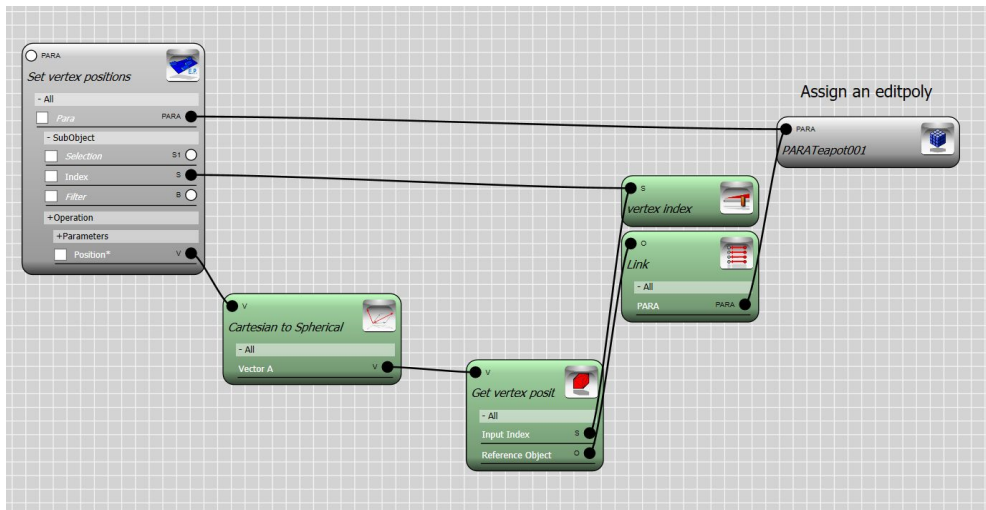
- **Map vector A from Cartesian to Cylindrical coord-sys:** converts the coordinates of the point A from cartesian (x,y,z) from to cylindrical (ρ,φ,z) using below formula :

$$\begin{aligned}\rho &= \sqrt{x^2 + y^2} \\ \varphi &= \begin{cases} 0 & \text{if } x = 0 \text{ and } y = 0 \\ \arcsin\left(\frac{y}{\rho}\right) & \text{if } x \geq 0 \\ \arctan\left(\frac{y}{x}\right) & \text{if } x > 0 \\ -\arcsin\left(\frac{y}{\rho}\right) + \pi & \text{if } x < 0 \end{cases}\end{aligned}$$

Example:

Open file C:\Program Files\Autodesk\3ds Max 2020\scripts\Para3D\Examples\VectorController\Cartesian to Spherical mapping.para

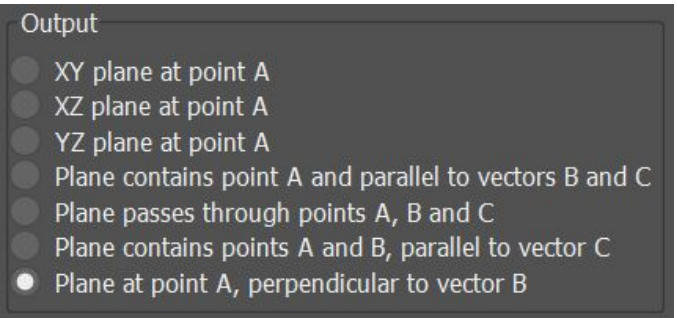
Paraflow maps the geometry from cartesian coordsys to spherical , note the location of the geometry with respect to the origin matters.



Matrix Output

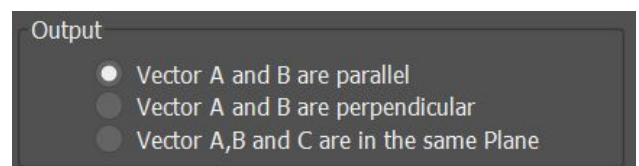
The following outputs are available in matrix format :

- **XY plane at point A:** Returns a plane parallel to the world XY plane at point A.
- **XZ plane at point A:** Returns a plane parallel to the world XZ plane at point A.
- **YZ plane at point A:** Returns a plane parallel to the world YZ plane at point A.
- **Plane contains point A and parallel to vectors B and C :** Construct an orthogonal transformation matrix on point A which contains vectors B and C.
- **Plane passes through point A,B and C :** Construct an orthogonal transformation matrix on point A which includes point B and C.
- **Plane contains point A and B, parallel to vector C:** Construct an orthogonal transformation matrix on point A which includes point B and parallel to vector C.
- **Plane at point A perpendicular to vector B:** Construct an orthogonal transformation matrix on point A with the normal vector B.



Boolean Output

The following outputs are available in boolean format :



- **Vector A and B are parallel:** Return true if two vectors A and B are parallel within the tolerance of 10^{-10}
- **Vector A and B are perpendicular:** Return true if vectors A and B are perpendicular within the tolerance of 10^{-10}
- **Vector A,B and C are in the same plane:** Return true if vectors A and B and C are coplanar within the tolerance of 10^{-10}