Let the angle of the given vector be measured with respect to the forward direction on each line segment (great circle segment) as it is being traversed. Traverse the triangle in the positive (counter-clockwise) sense. At each vertex the direction of the path rotates by the exterior angle: $\pi-$ (interior angle) . (This is obvious if one considers reversing direction – the interior angle goes to zero but the direction obviously changes by nearly 180 degrees.) The direction of the given vector thus rotates with respect to the path direction by the negative of this angle. Summing the change around the three vertices of the triangle, one gets $-3\pi+$ (sum of interior angles) $=-3\pi+(\pi+$ area of triangle). So the angle of rotation in the positive sense is just equal to the area of the spherical triangle.