

SmartUnfold

By Solid3dTech

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SmartUnfold is an AutoCAD plug-in that can expand, unfold or unroll surfaces for many different types of industrial products including ship hulls, sheet metal surfaces, clothing, etc. SmartUnfold is also capable of unfolding the most complex compound-curvature and developable surfaces, trimmed or untrimmed.

Overview

This document will guide you how to use the command < SmartUnfold > inside AutoCAD. It includes many samples.

Unfolding

There are two different kinds of surfaces related to the unfolding procedure: developable and undevelopable. A developable surface has a zero Gaussian curvature, e.g. cylinders, cones or any ruled surfaces. An undevelopable surface should have compound/double curvatures, such as hull surfaces, etc. A surface is unfolded based on its type.

A surface that has a zero Gaussian curvature is also a ruled surface. To unfold such kind of surface, you can simply expand the two curved edges and keep the length of any linear isometric lines between curved edges and angles between linear isometric lines and curved edges in 3D unchanged on the 2D plane. Any point on the expanded (or unfolded) surface is mapped to a unique point on the surface in 3D. The whole expanding (or unfolding) procedure is governed by exact mathematic mapping equations and transformations. In the case of a trimmed surface, the trimmed contours are calculated based on the underlying expanded untrimmed surface.

However, expanding a surface with double curvatures is an approximation procedure as there are no exact mathematic equations to guide the expanding procedure. The surface to be unfolded is represented as a Nurbs surface with "u" and "v" as parameters along u and v directions. Therefore, the surface is internally approximated by a mesh consisting of many quadrilaterals along the "u" and "v" directions (small rectangular shaped elements). Then, the center point for the expansion is automatically calculated based on the curvatures of the surface. The center point is basically a point on the flat area of the surface. Then each rectangular element will be laid out flat near the center point along the "u" or "v" directions of the surface. The adjustment for each step is determined based on the curvatures of the surface for each quadrilateral.

Unfolded Surface Alignment

In case two or more developable surfaces are selected in the same time to be expanded, the expanded surfaces will be aligned on the XY-Plane along the common edges between each pair of adjacent surfaces. Examples 9 and 10 show the surface alignment.

Command Format

Command: AutoUnfold (or UnfoldSurf)

Please Select Surfaces For Unfolding (press <enter> to end the selection):

If the user selects only one surface for unfolding, the command will again ask users to select the curves or/and the points for unfolding. The user will see the following prompt when just one surface is selected:

Please Select Curves/Points For Unfolding (press <Enter> to end the selection):

Unfolded Results

If only one surface is selected, then the unfolded contour is saved in the current layer. If two or more surfaces are selected, SmartUnfold will group all the unfolded boundary contours based on the common edges between each pair of surfaces in 3D. Each group of surfaces will be aligned along the common edges between the surfaces. Then for each group, two layers will be created: <UnfoldedCurvesLayer> and <UnfoldedPolygonLayer>. In <UnfoldedPolygonLayer>, each boundary of the expanded surface will be saved in a single polygon. All boundary curves for the whole group are saved in the layer <UnfoldedCurvesLayer>.

Common Issues

- a. Some surfaces are not developable: SmartUnfold cannot expand surfaces like spheres and torus surfaces.
- b. If the model is a solid: the command <Explode> should be used to generate the surfaces before unfolding is possible.
- c. Proxy entities in AutoCAD can't be selected for expansion. The properties of the entity will show you whether or not the entity is a proxy entity or not.
- d. If a model loaded into AutoCAD with command <Insert> can't be expanded, the model should be converted to IGES file and reloaded into AutoCAD. Solid3DTech provides a tool to import any IGES file into AutoCAD.
- e. When you select any curves/points for unfolding with the surface together, the curves/points must be on the surface to be unfolded. The results will be wrong to unfold any curves/points that not on the surface.
- f. If you have any model from Inventor, then you have to save the model into a sat file and import it into AutoCAD. If you save the model from Inventor into a DWG file and load the model into AutoCAD, then this plugin can't handle such model as all entities from Inventor are proxy

entities in AutoCAD, the geometric data information from the model is not accessible in AutoCAD.

Unfolding Samples

The following examples can be found in the files you have downloaded. Each sample can be opened to repeat the expansion procedure. All models are displayed in red and all the expanded contours are in blue. Samples are only for AutoCAD 2007 or later.

- Sample 1: The surface in fig. 1 is a deck surface.

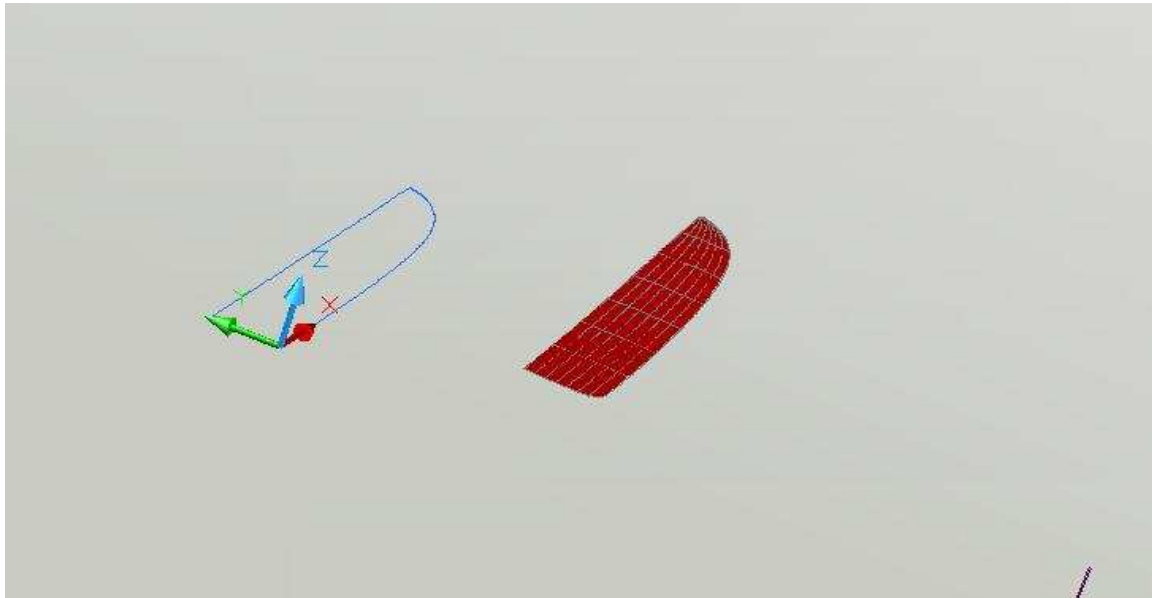


Fig. 1.

- Sample 2: the surface is a hull surface from a ship.

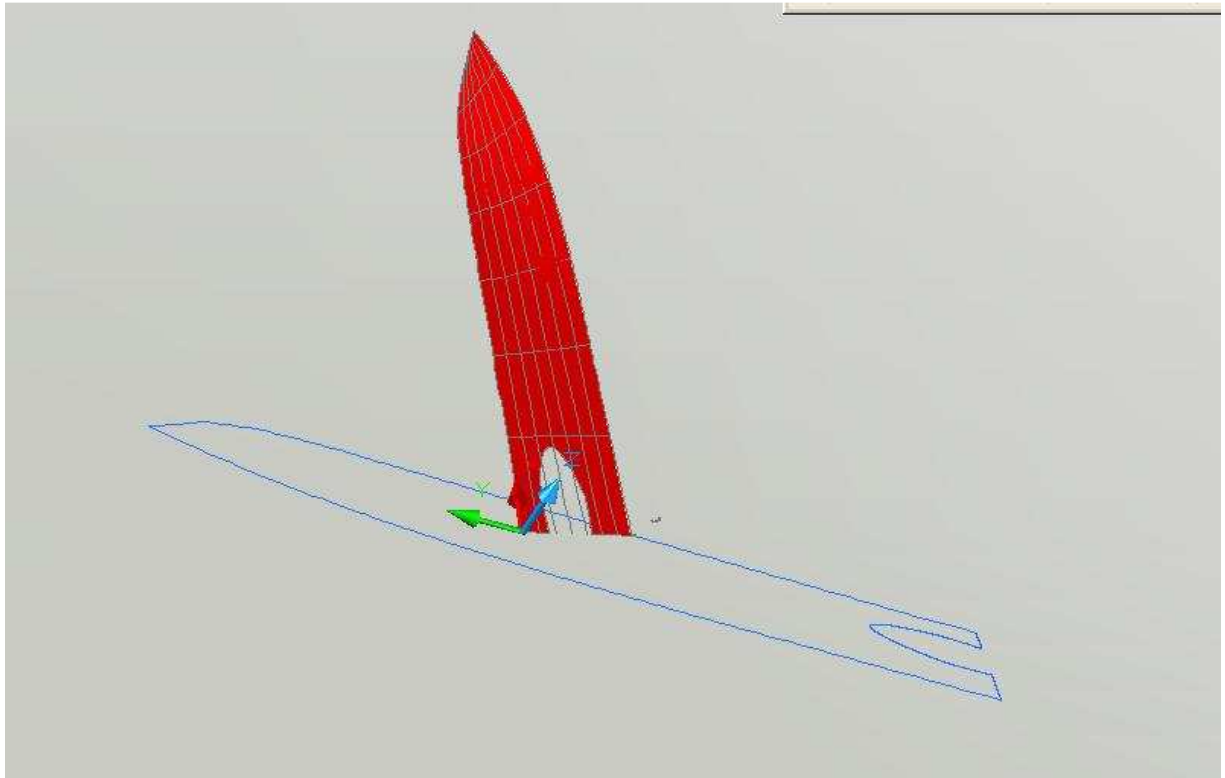


Fig 2.

- Sample 3: The surface is trimmed cone surface.

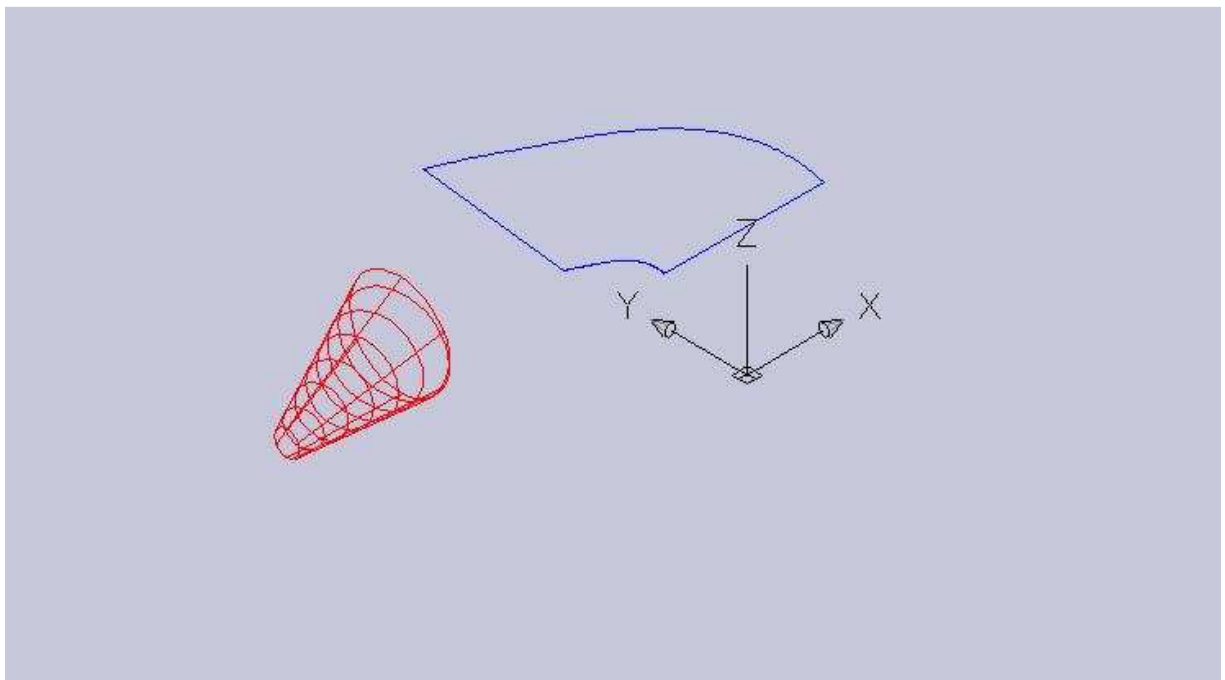


Fig 3.

- Sample 4: The surface is a cone surface. The line and two points are also unfolded.

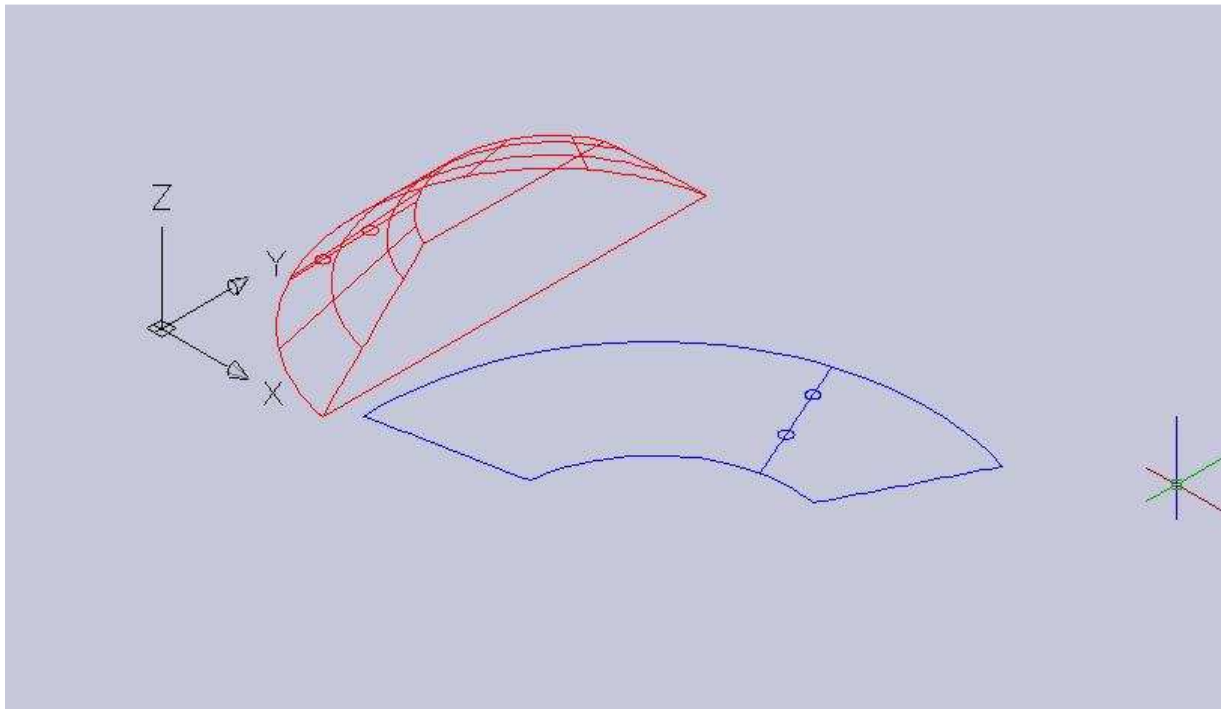


Fig 4.

- Sample 5: The surface has double curvatures. The three points and one curve is also unfolded with the surface.

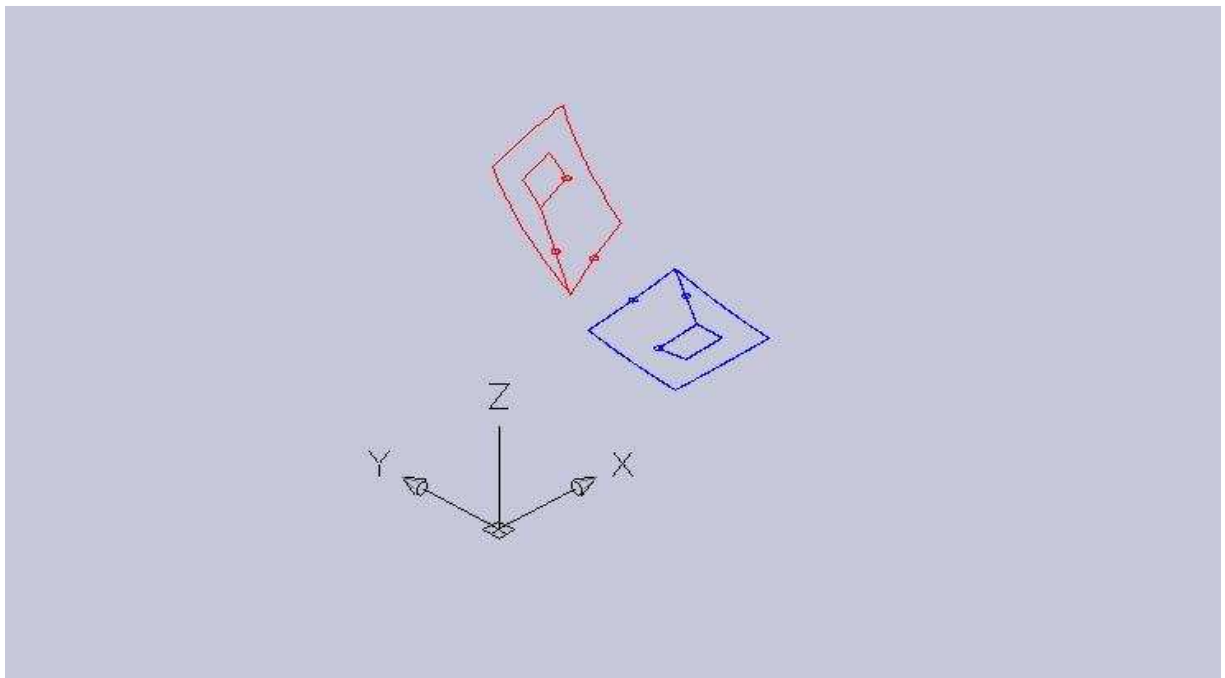


Fig 5.

- Sample 6: The surface is a corrugated surface.

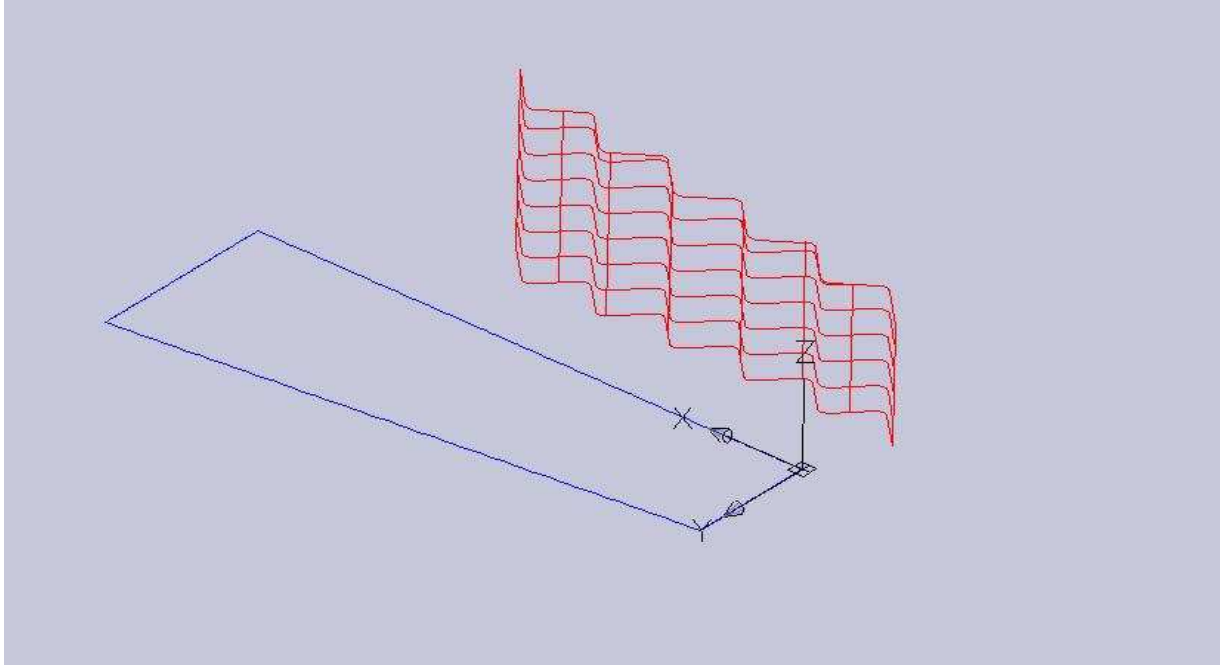


Fig 6.

- Sample 7: The surface is a cone surface where the base curve is a ellipse (elliptical cone surface).

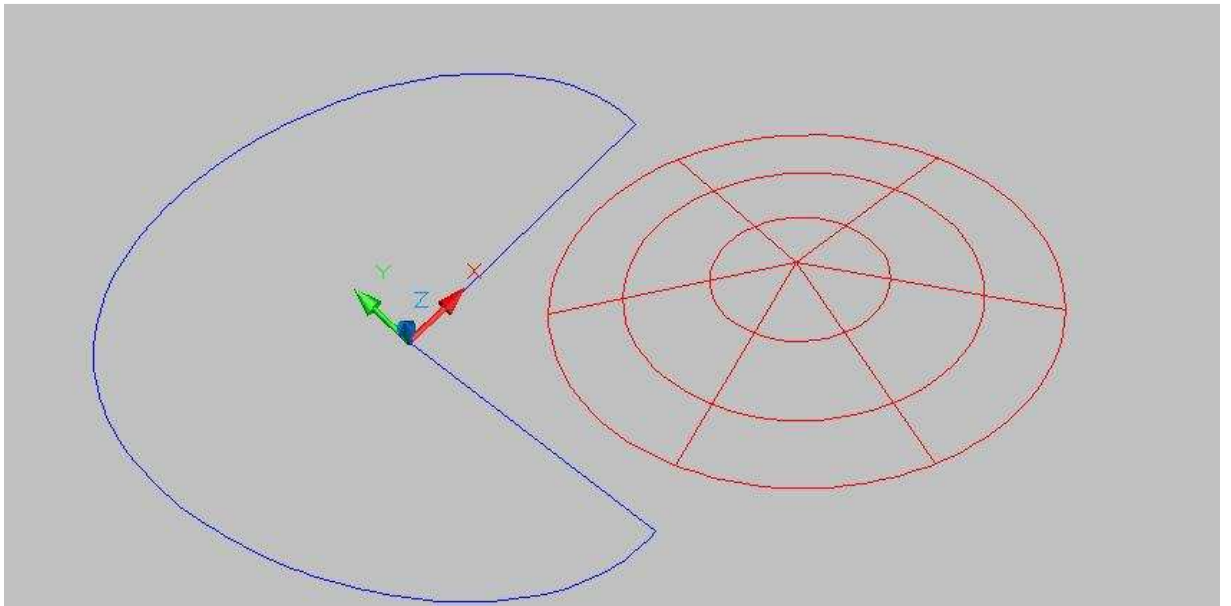


Fig 7.

- Sample 8: A slanting cylinder surface. The line and two points are unfolded with the original surface.

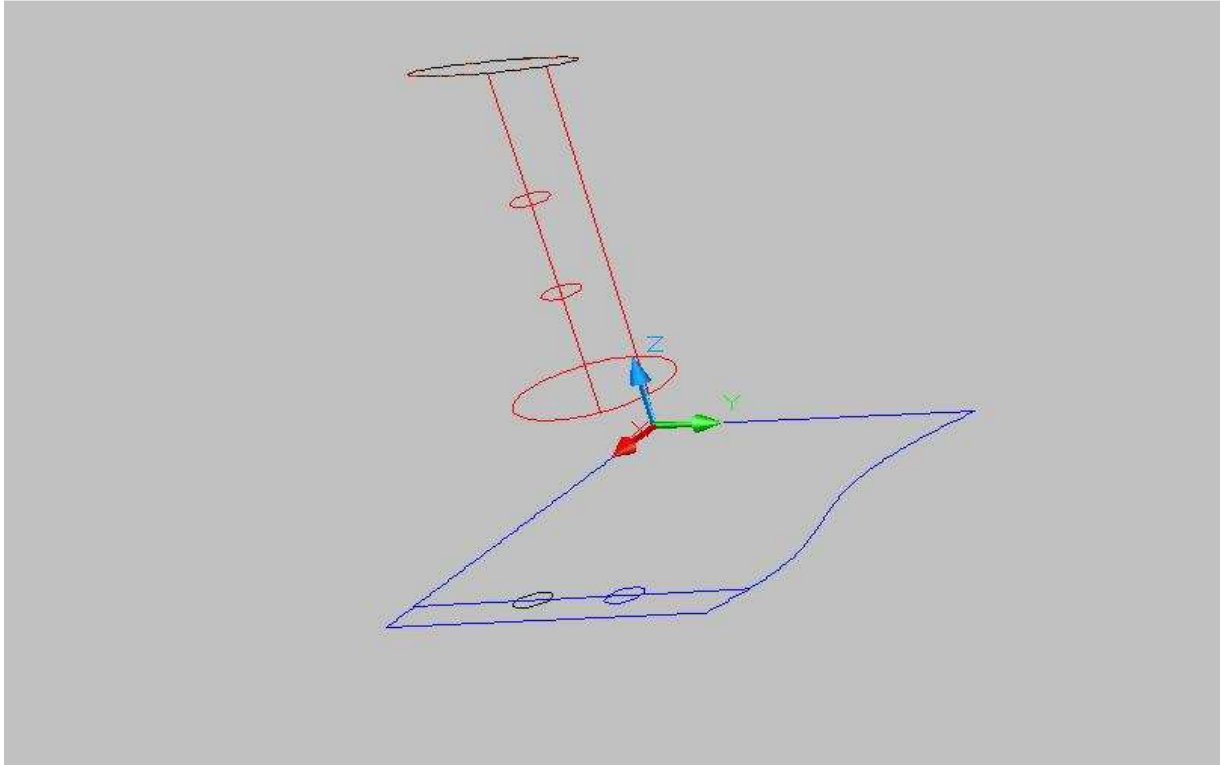


Fig 8.

- Sample 9: Multi surfaces are expanded in the same time and the unfolded contours are aligned in the XY-plane.

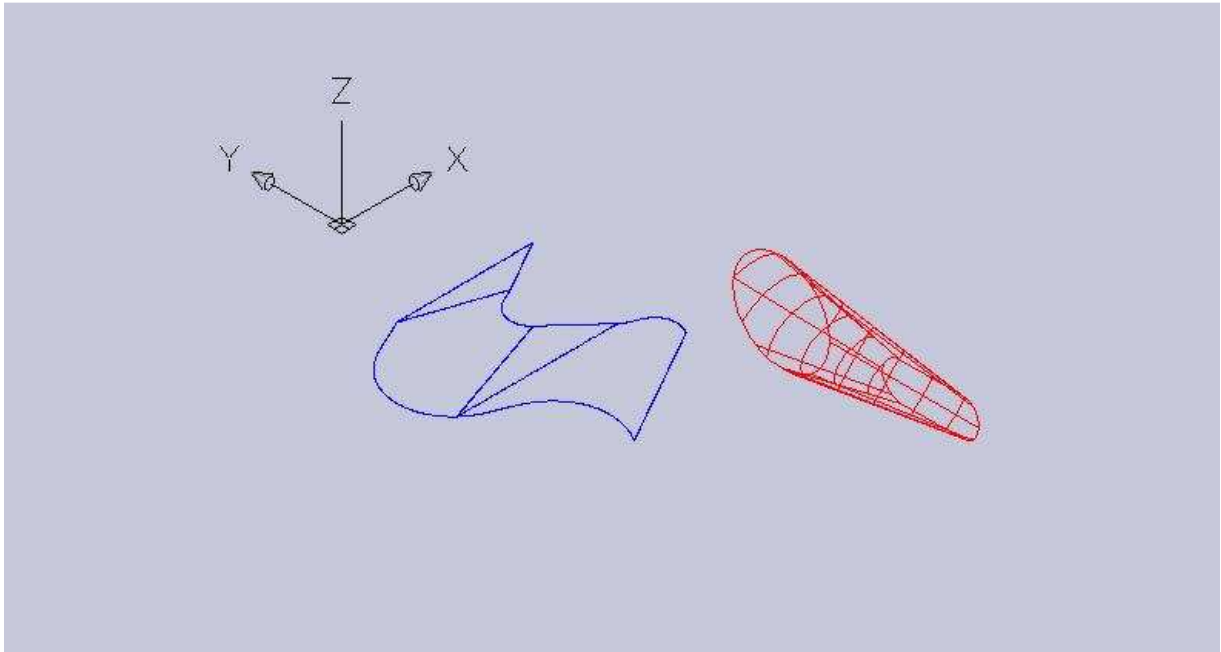


Fig 9.

- Sample 10: The multi surfaces are unfolded and the expanded contours are aligned.

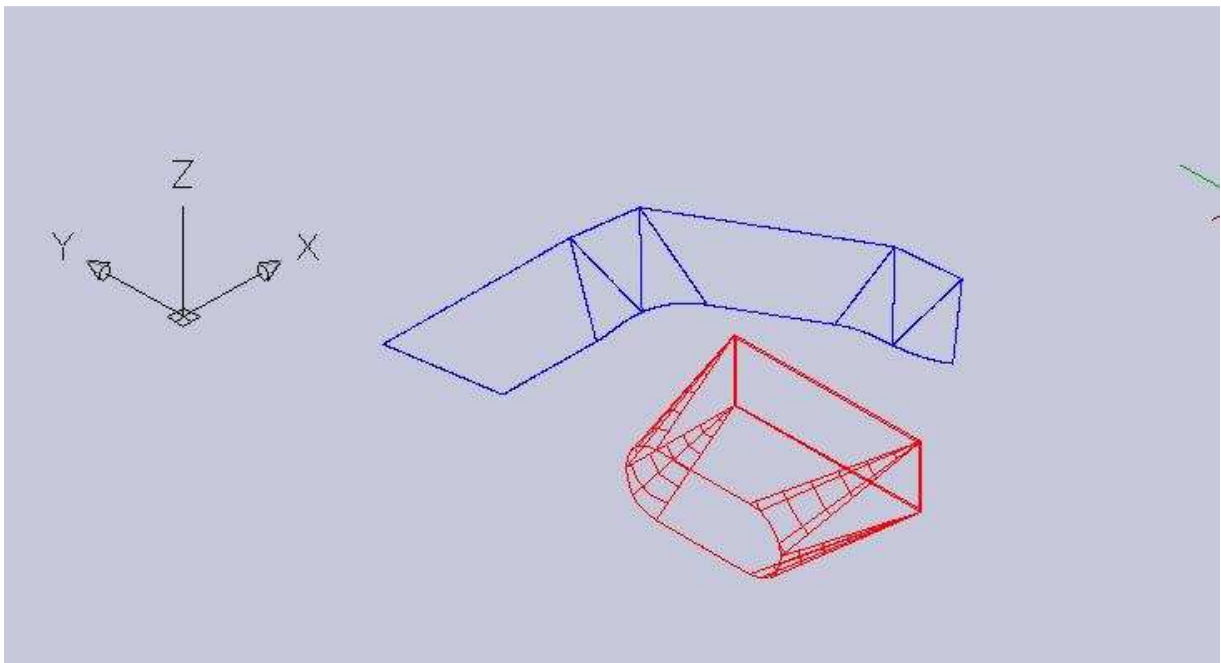


Fig 10.

