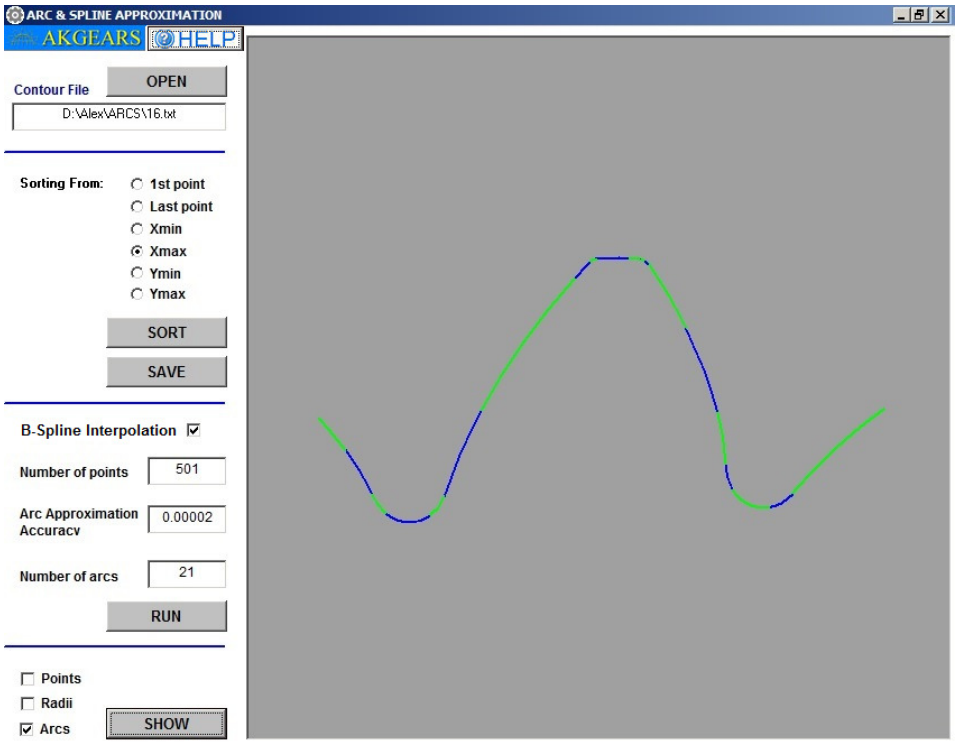
Spline Interpolation and Tangent Arc Approximation Program

(User Manual)



This program serves to convert the 2D contour profiles presented by the points (X, Y, Z coordinate array, though the Z-coordinate is not used for calculation) into the DXF CAD files containing the interpolating B-spline curve and/or approximating tangent circular arcs. The B-spline curve connects consequently every point of the profile. The tangent circular arcs are connected with each other and also have equal 1^{st} derivative in the connecting points. It makes a smooth profile curve. A number of the arc depends on the selected accuracy, - a biggest distance from approximated points to the related arc.

This manual presents a step-by-step procedure for the program user.

1. Input Data

The application comes with a few input sample files that can be found in *My Documents/AKGears\Spline and Arcs* folder. The input data file with extension .txt or .dat contains a contour presented by the X, Y, Z point coordinates. If the contour is a closed loop, its first and the last points are coincide.

After clicking the "OPEN" button select the input sample file (Fig. 1).

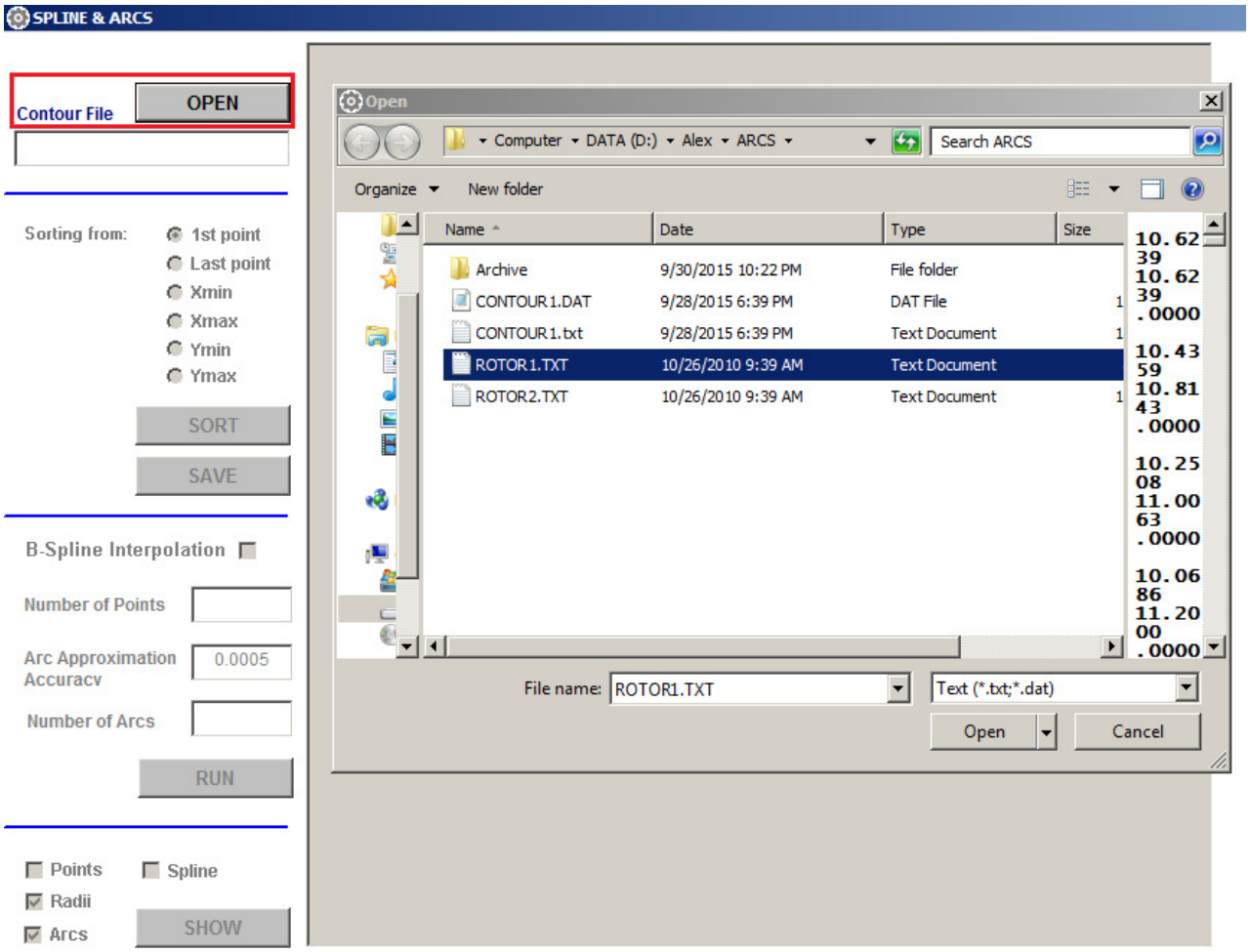


Fig. 1. Contour file selection.

The contour file name will appear in the Contour File window and its points in blue color will appear on the screen. A number of points will be shown in the window as well (Fig. 2).

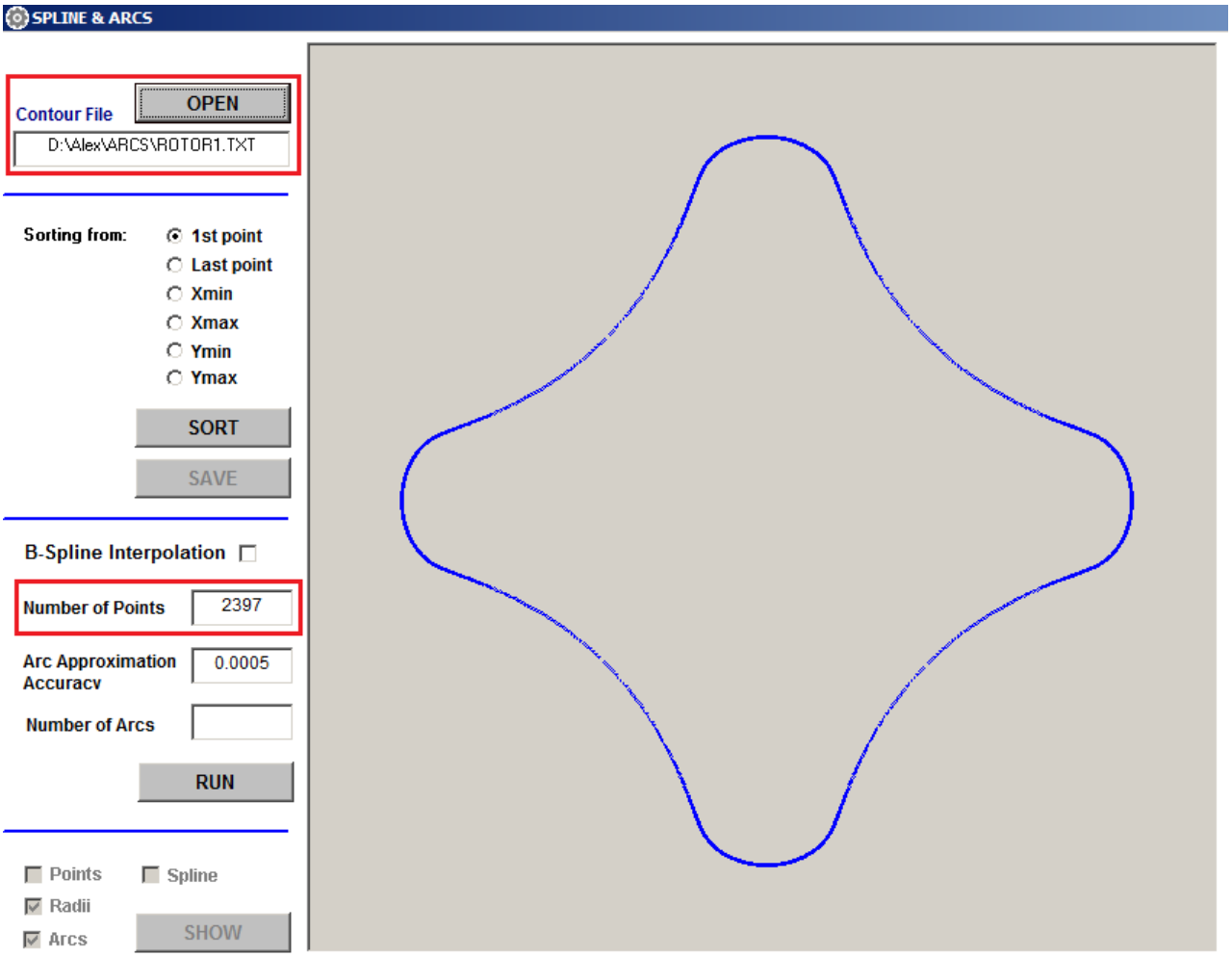


Fig. 2. Contour file.

2. Contour Point Sorting

If the contour points are in a random order, they can be rearranged by sorting them in the consequent order (Fig. 3). After the sorting the contour point color will be changed from blue to yellow.

For the closed loop contour (Fig. 3a) the sorting starting point position does not matter. For the open contour (Fig. 3b) the sorting starting point position must be at the end of the contour. If the sorting starting point position is not at the end of the contour, the point sorting will not cover all points and the warning message “Start Sorting from Other Point” will appear. If this warning is disregarded, than only sorted yellow points will be used for B-spline interpolation and/or tangent circular arc approximation, the unsorted blue points will be ignored.

After the sorting the contour point file can be saved under the same or other name (Fig. 4).

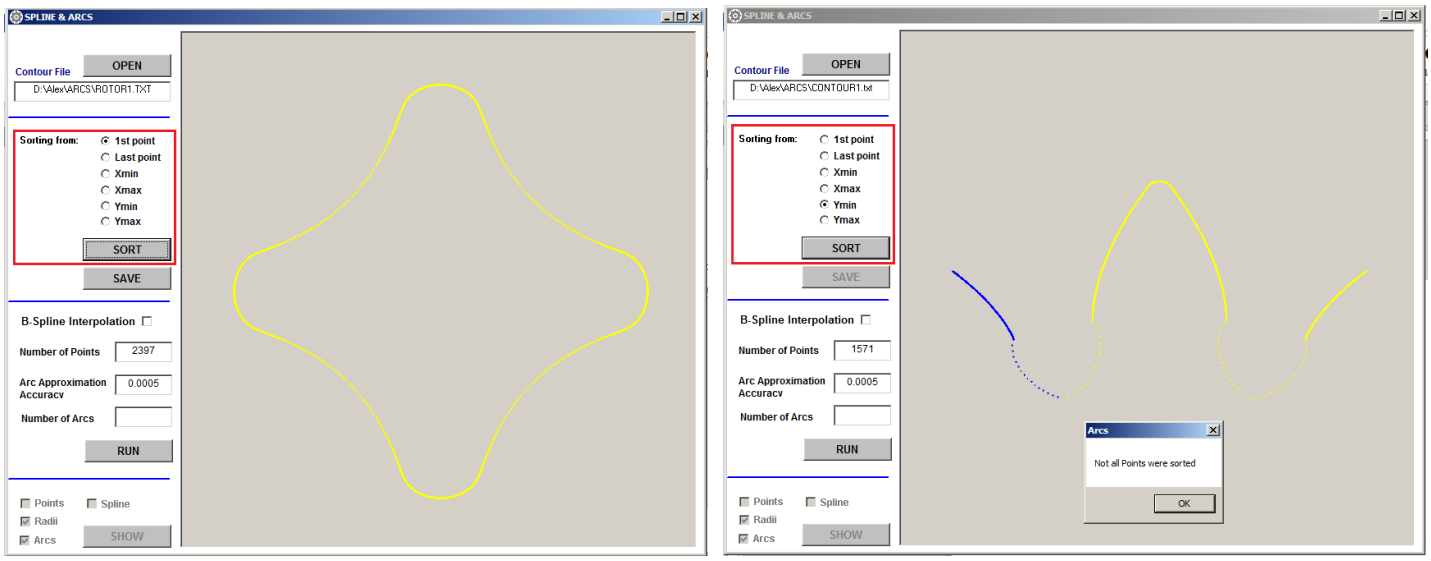


Fig. 3. Contour point sorting; a – closed loop contour, b – open contour

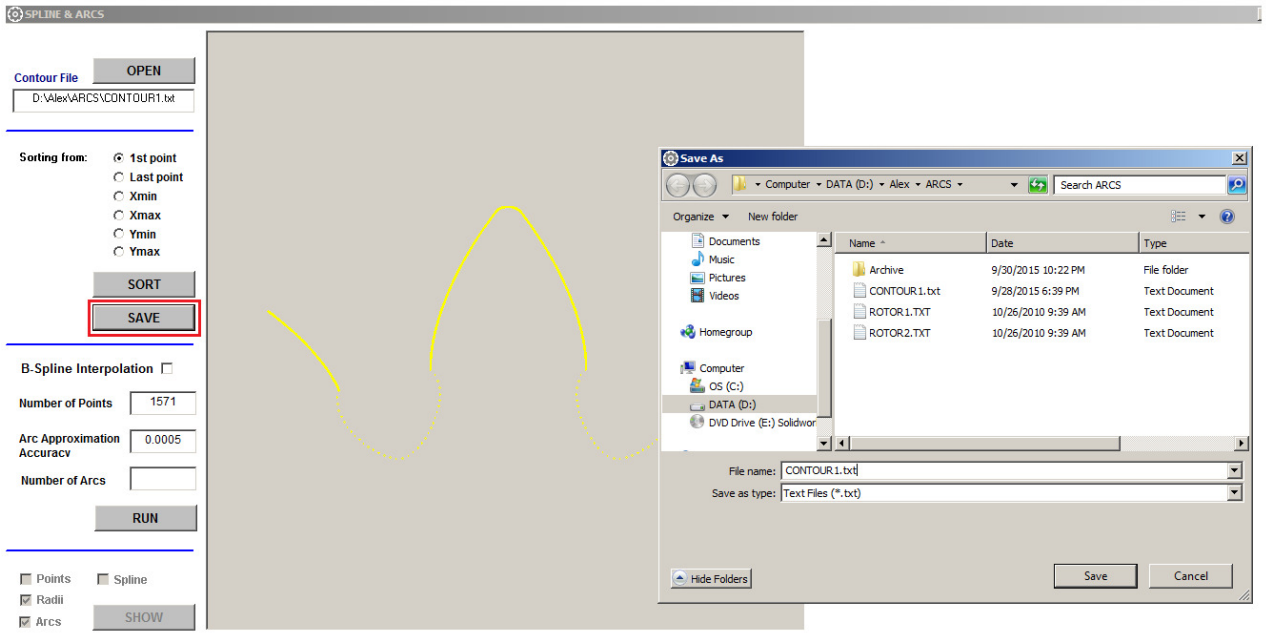
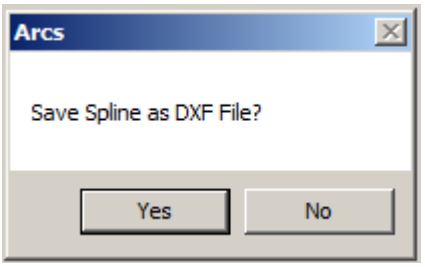


Fig. 4. Saving of the sorted contour point file

3. B-spline Interpolation

In order to proceed with the B-spline interpolation, the “B-spline interpolation” checkbox should be checked. The B-spline interpolation is also setting the equally spaced points in the spline curve. A number of these points is inputted in the “Number of Points” window. It can be different than the initial number of points. Clicking the bottom “RUN” starts the B-spline interpolation. Then the text file SPLINE.dat with the X,Y coordinates of the equally space contour point is created automatically.

After the B-spline interpolation is done the message 

will appear. The spline DXF file can be saved to use it for the CAD modeling (Fig. 5).

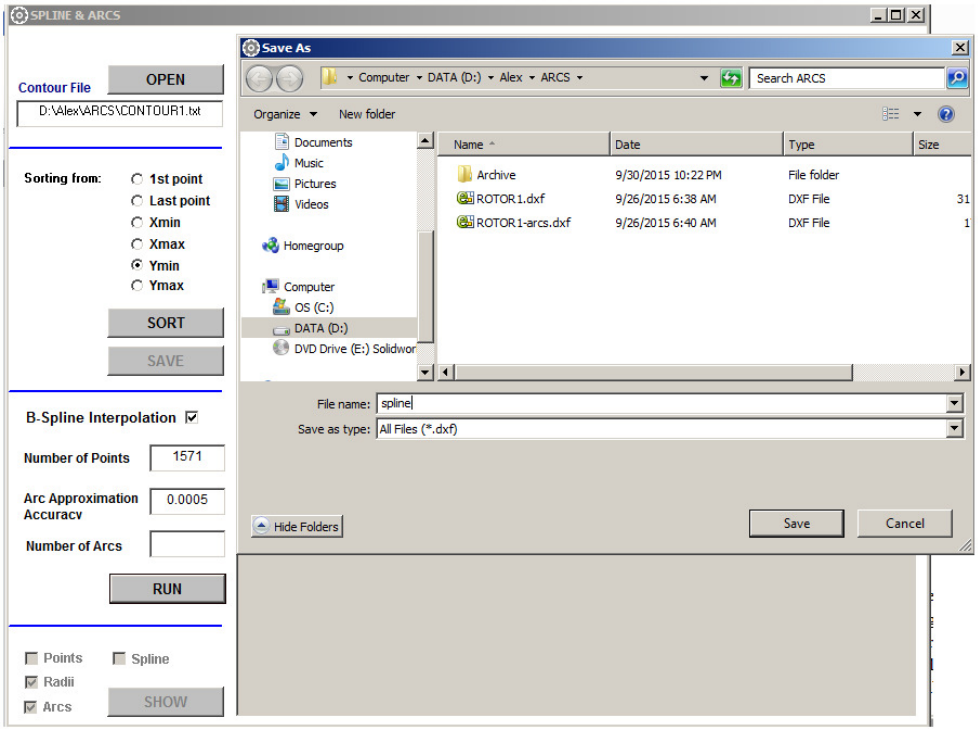


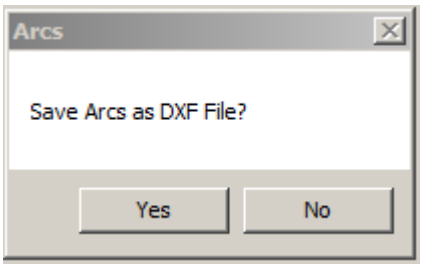
Fig. 4. Saving of the spline DXF file

4. Tangent Arc Approximation

Arc approximation accuracy establishes the maximum normal distance from the contour points to the approximating arcs. It is selected based on the part accuracy requirements, applied manufacturing technology and inspection equipment accuracy. For the English system recommended accuracy is 0.00002”, For the Metric system recommended accuracy is 0.0005 mm. The higher a number of contour points the higher a number of the approximating tangent arcs. In order to reduce a number of arcs the accuracy should be reduced accordingly. Arc approximation accuracy is inputted in the “Arc approximation accuracy” window.

The tangent arc approximation does not require the prior B-spline interpolation. However, it is recommended, if distances between neighboring contour points are significantly different. If the “B-spline interpolation” checkbox is checked, the tangent arc approximation starts

automatically after the B-spline interpolation. If the “B-spline interpolation” checkbox is unchecked, the tangent arc approximation starts by clicking on the “RUN” button.

After the tangent arc approximation is done the message 

will appear. The tangent arcs DXF file can be saved to use it for the CAD modeling (Fig. 6).

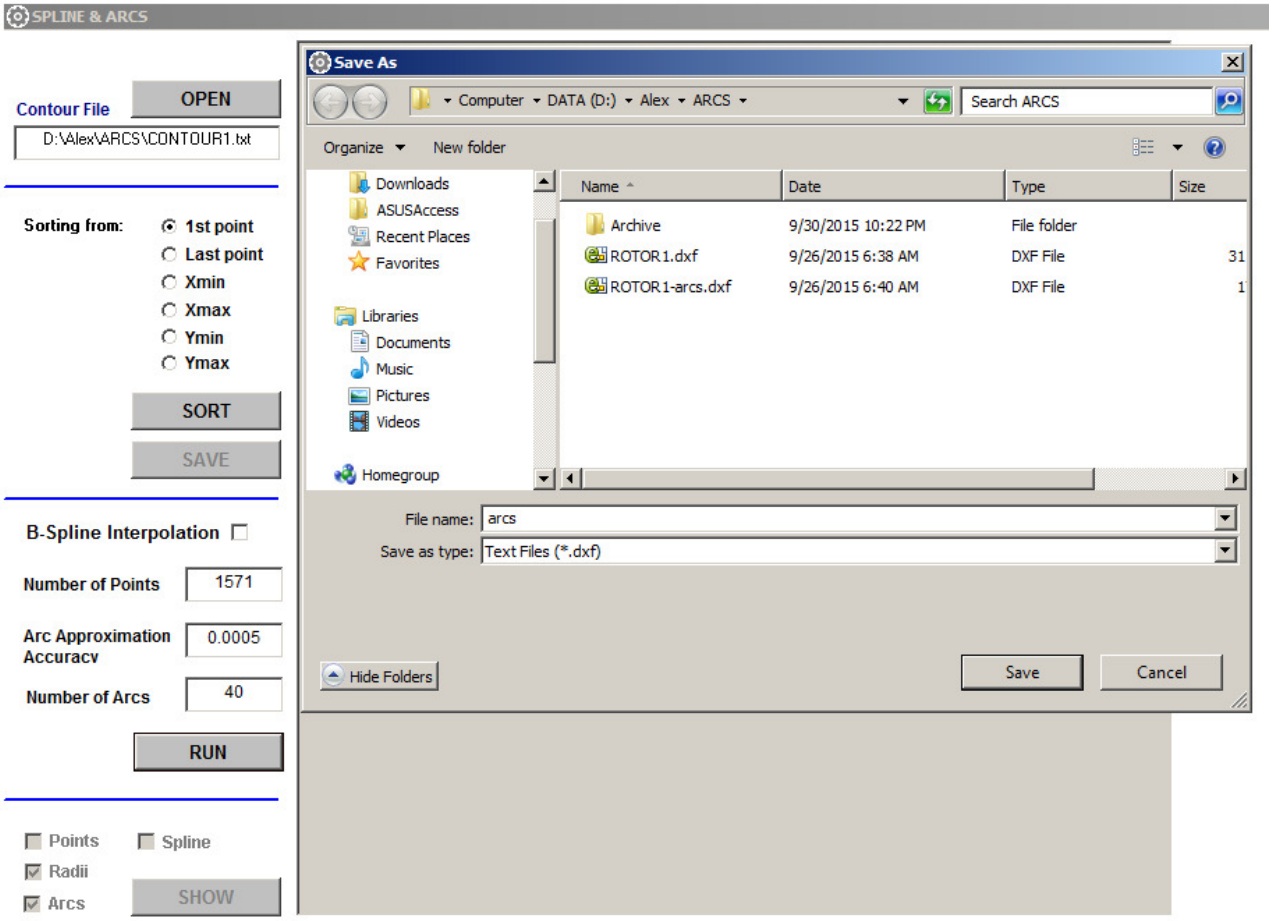


Fig. 6. Saving of the tangent arcs DXF file

5. Graphic Options

The original contour points (pink), spline curve (red), tangent arcs (blue and green), and the tangent arc radii (yellow with the black center points) can be shown separately or all together (Fig. 7) by clicking the “SHOW” button.

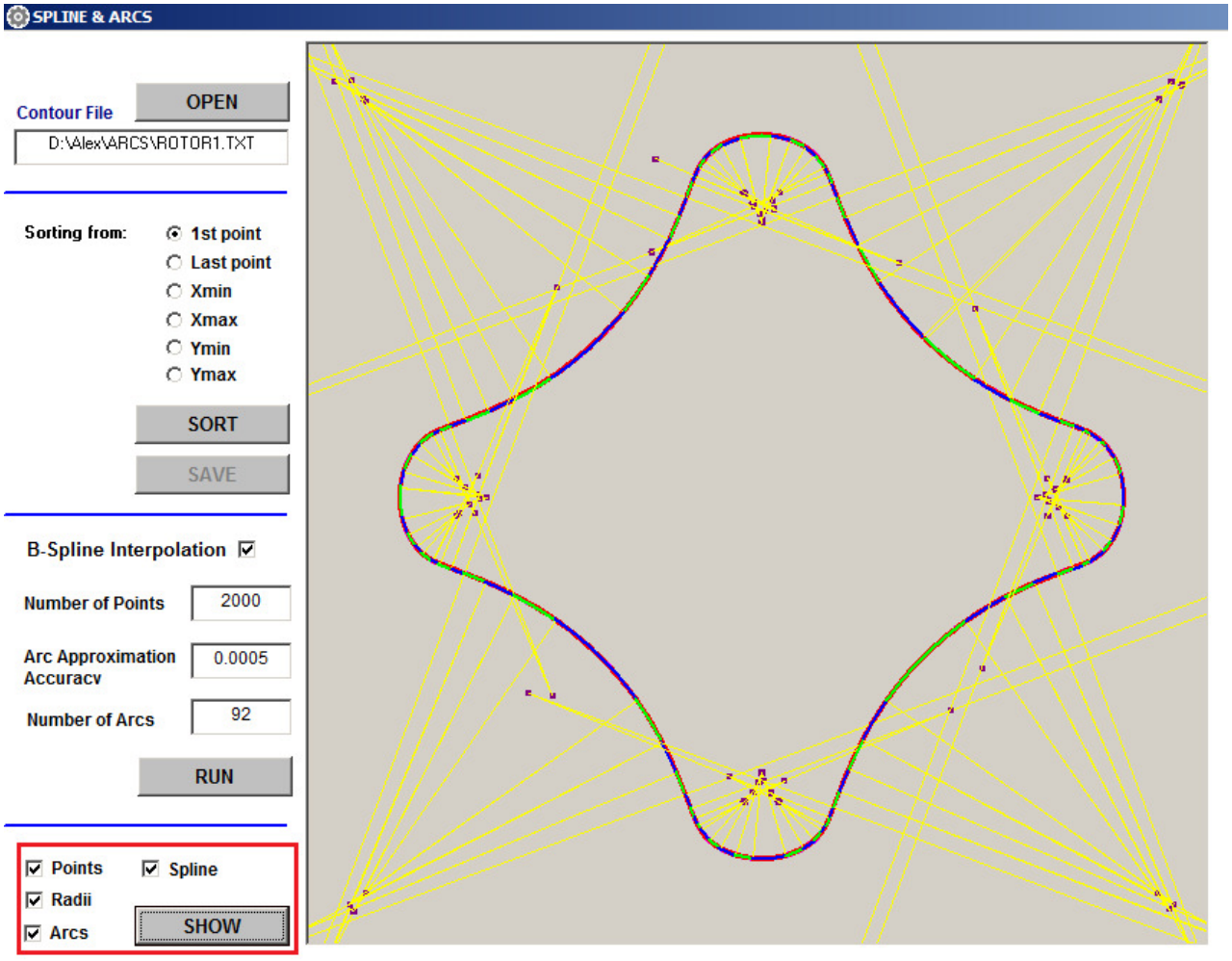


Fig. 6. Graphic result presentation

6. Attachments

The open (CONTOUR1.txt) and closed loop (ROTOR1.TXT) contour point sample files accompany this program.