Circular Arc Approximation of Pointwise Curves for Use in the NC Programming

D. Fidanov[1] M. Paskova[2] R. Angelov[2] V. Bodurov[2]
Instructor: Dragomir Aleksov[2]

[1]Faculty of Physics
Plovdiv University

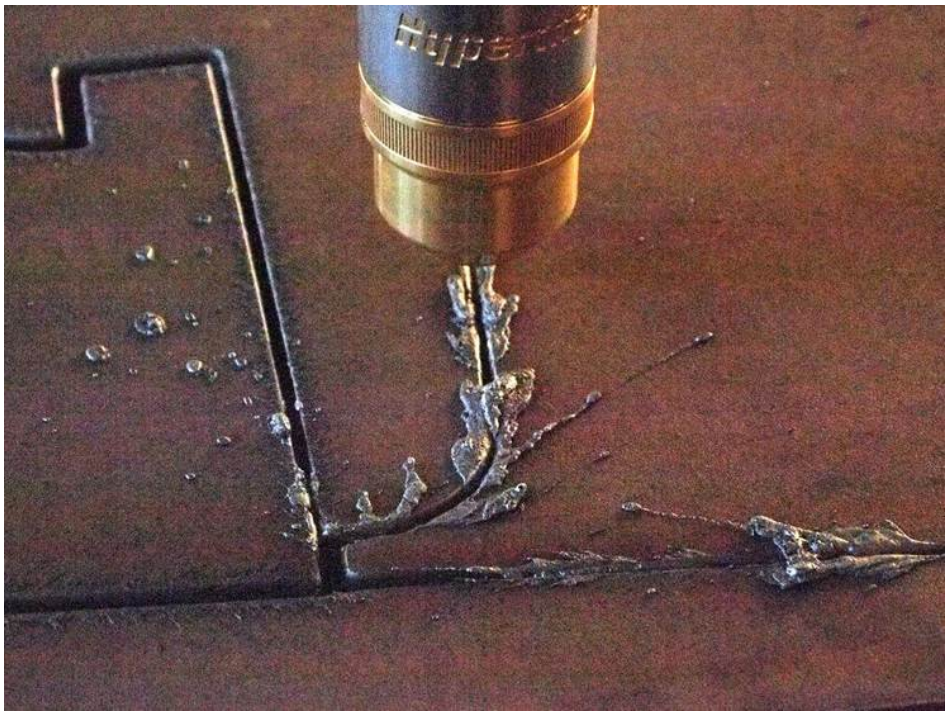
[2]Faculty of Mathematics and Informatics
Sofia University

Preparatory Modelling Week

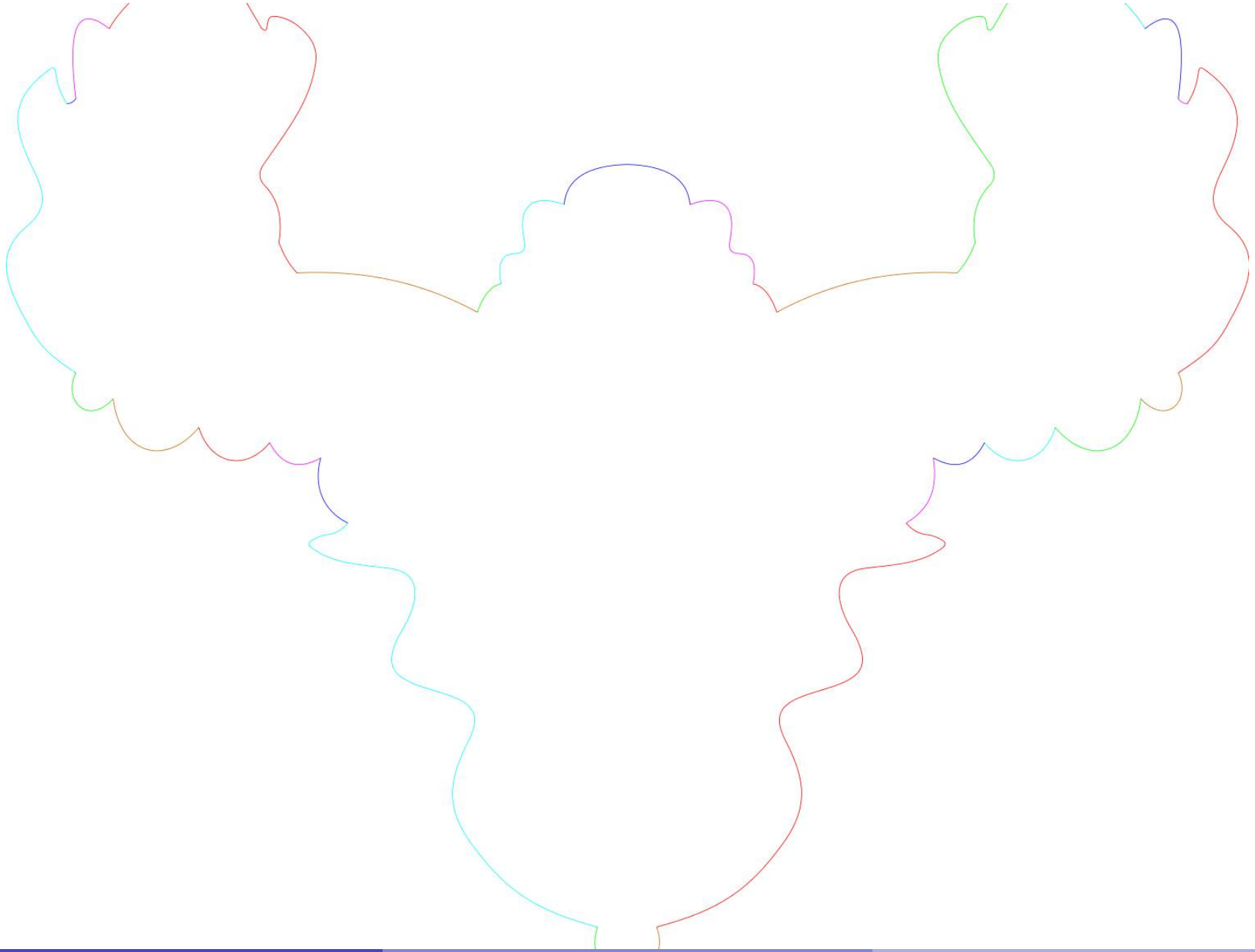
Outline

Description of the Proposed Problem

- NC (Numerical Control) machine.
- Limitations of the device.
- Input: $\{(x_1, y_1), (x_2, y_2), (x_c, y_c), E\}$

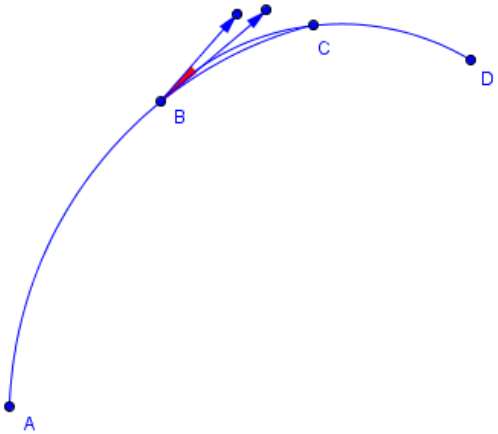


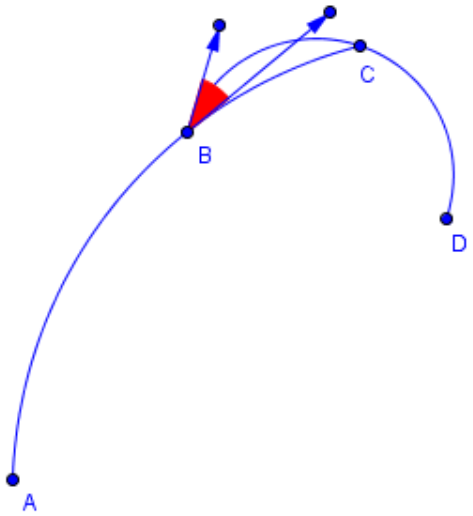
Example Of An Industrial Component



Wednesday Summary

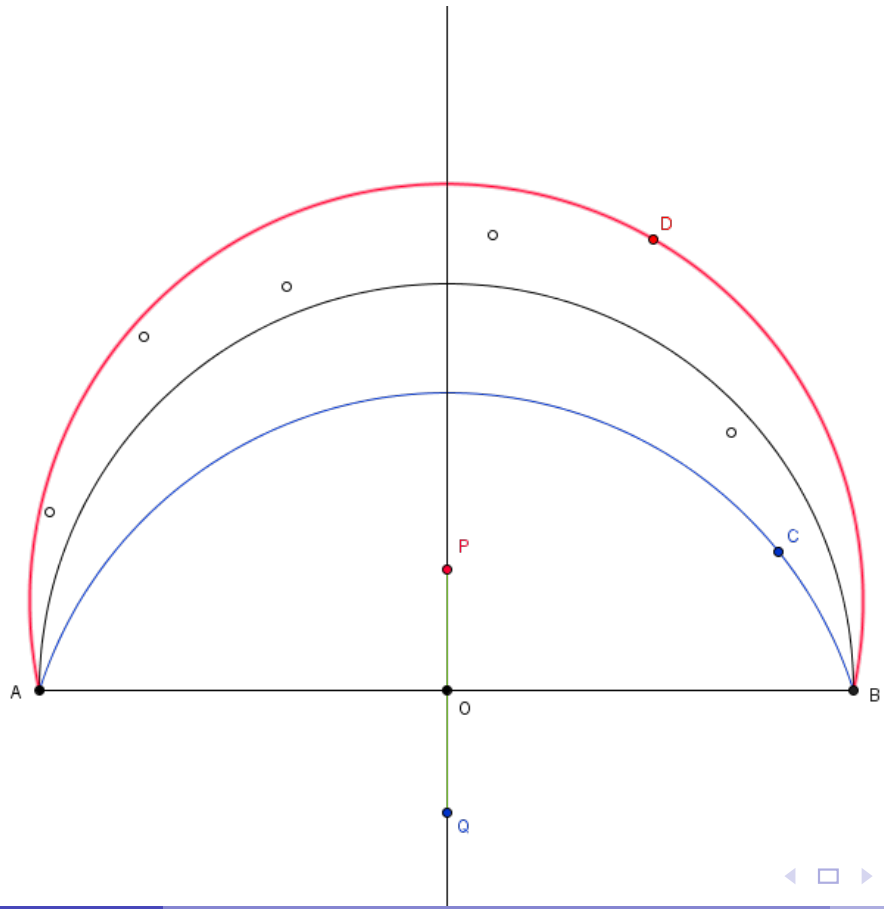
- We presented an algorithm consisting of two basic steps.
- Draw two arcs and compare the angle between them.





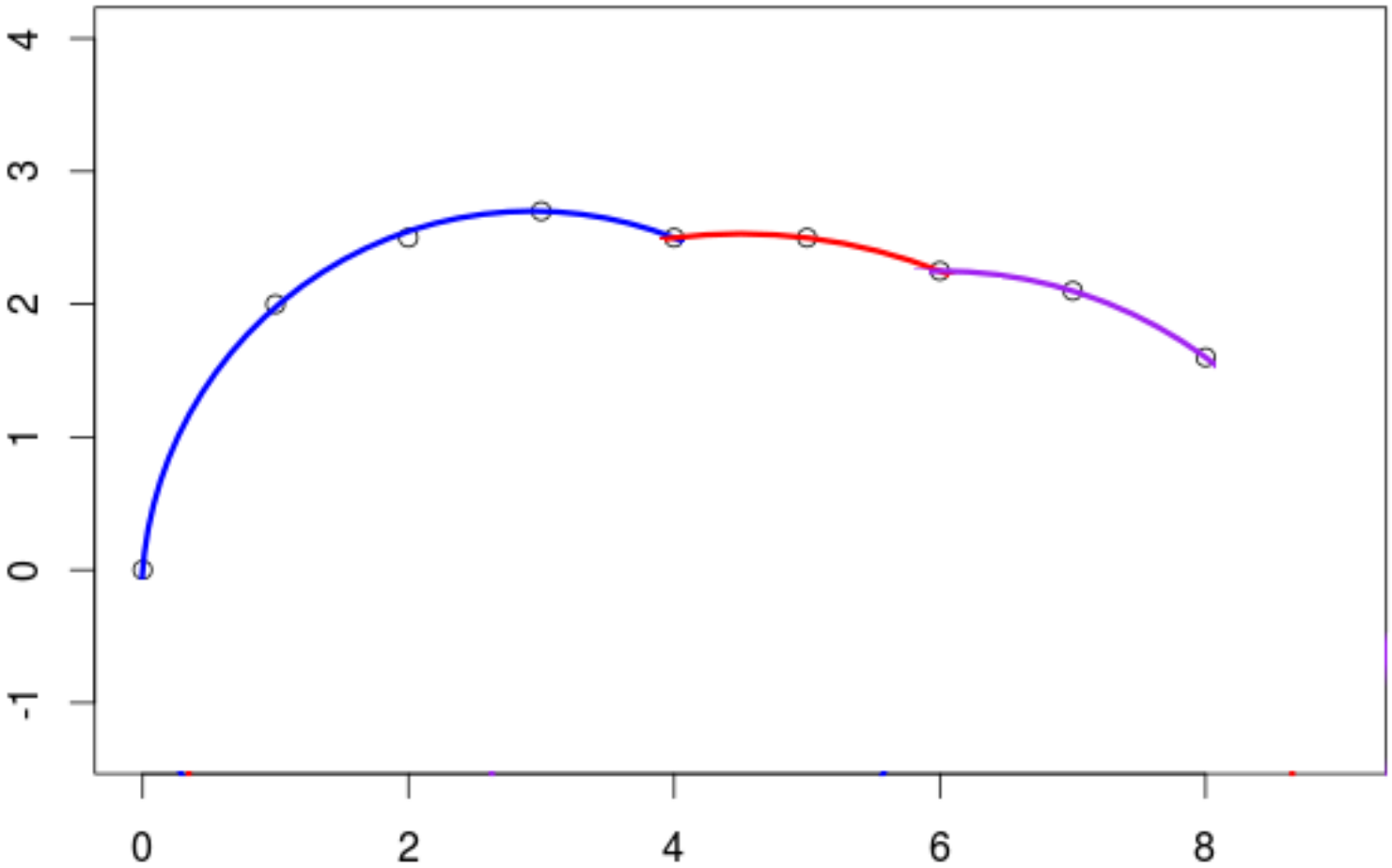
- If the angle is "sufficiently" small, try to find an "optimal" arc approximating all points.
- Continue in an iterative way.

- Let us draw two circular arcs l and m through the points A, B, C and A, B, D,respectively.
- Let K denote the set of all given points.
- $\overset{\frown}{ACB}$ is the "smallest" arc
- $\overset{\frown}{ADB}$ is the "biggest" arc
- Choose the center $O \in [P, Q]$ for the "optimal" arc.

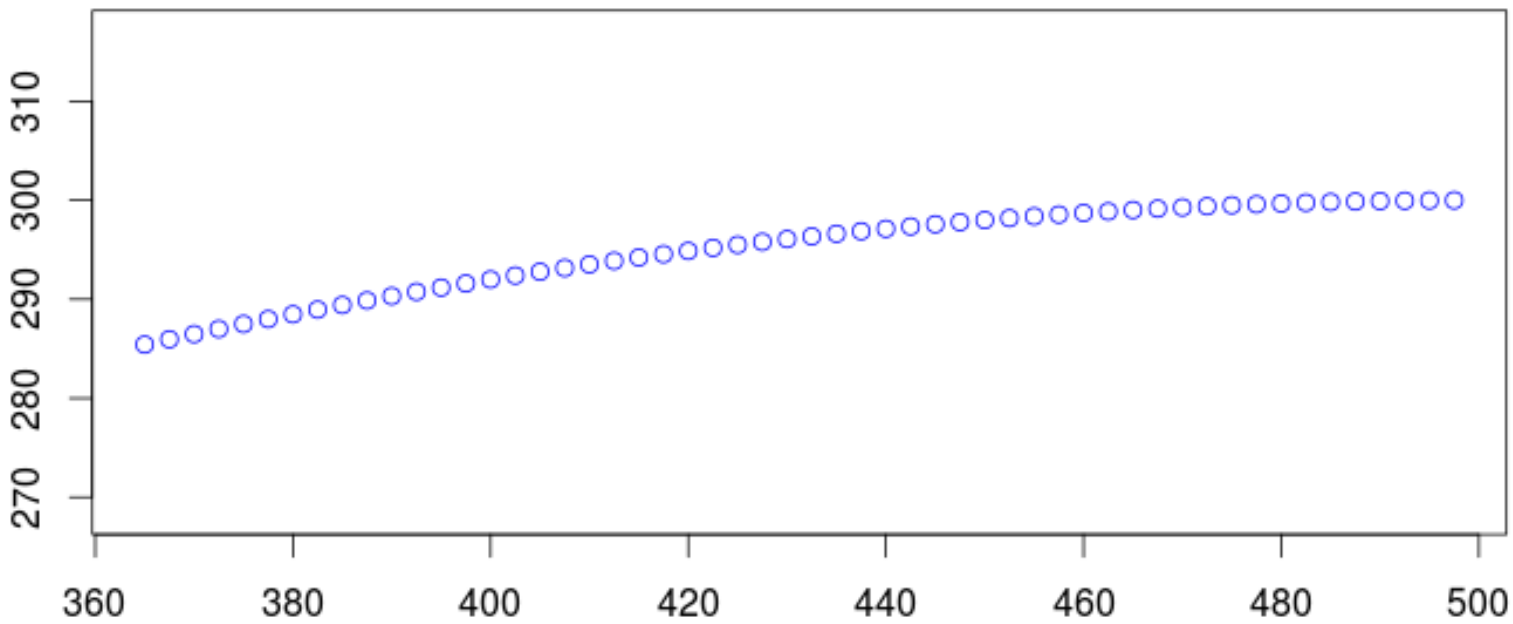


Wednesday Summary

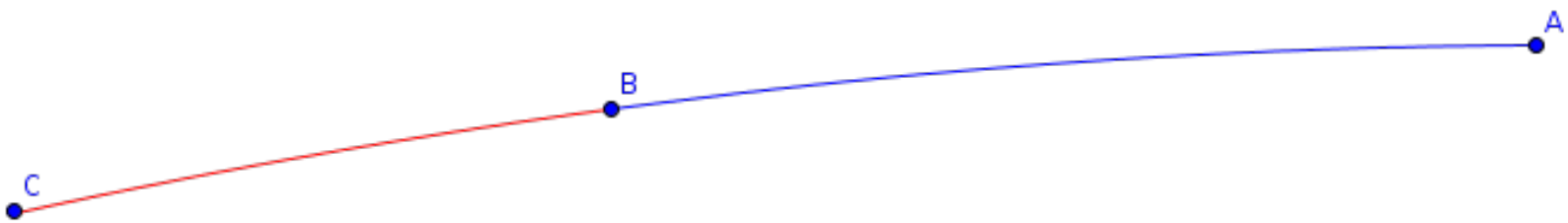
- Starting with a toy set of 9 points the following results were obtained



Results



Results



Arc	Error
Arc $\overset{\frown}{AB}$	0.0054
Arc $\overset{\frown}{BC}$	0.0041

Goal: Error below 0.01!

Details of the Proposed Solution

- Let us perform the obtained algorithm with a predetermined tolerance level $\varphi > 0$ for the angle in radians between two consecutive circular arcs.
- Take one positive number m ($m = 0.01$ in our case).
- Let $d_1, d_2, ..., d_n$ be the maximal Hausdorff distances of each circular arc to a nearby point.
- Let $d = max(d_1, d_2, ..., d_n)$
- If $d > m$ then perform the algorithm with $\varphi := \frac{\varphi}{10}$ until $d \leq m$.

Further Development

- Algorithm improvements for complete automation of the process.
- We are interested in finding a way of applying the obtained algorithm for the case when the set of points resembles a closed curve.
- Some theoretical considerations.

Finally...

Thank you for your attention!