Digital version

ENGS241 Computer Aided Design - Homework 5

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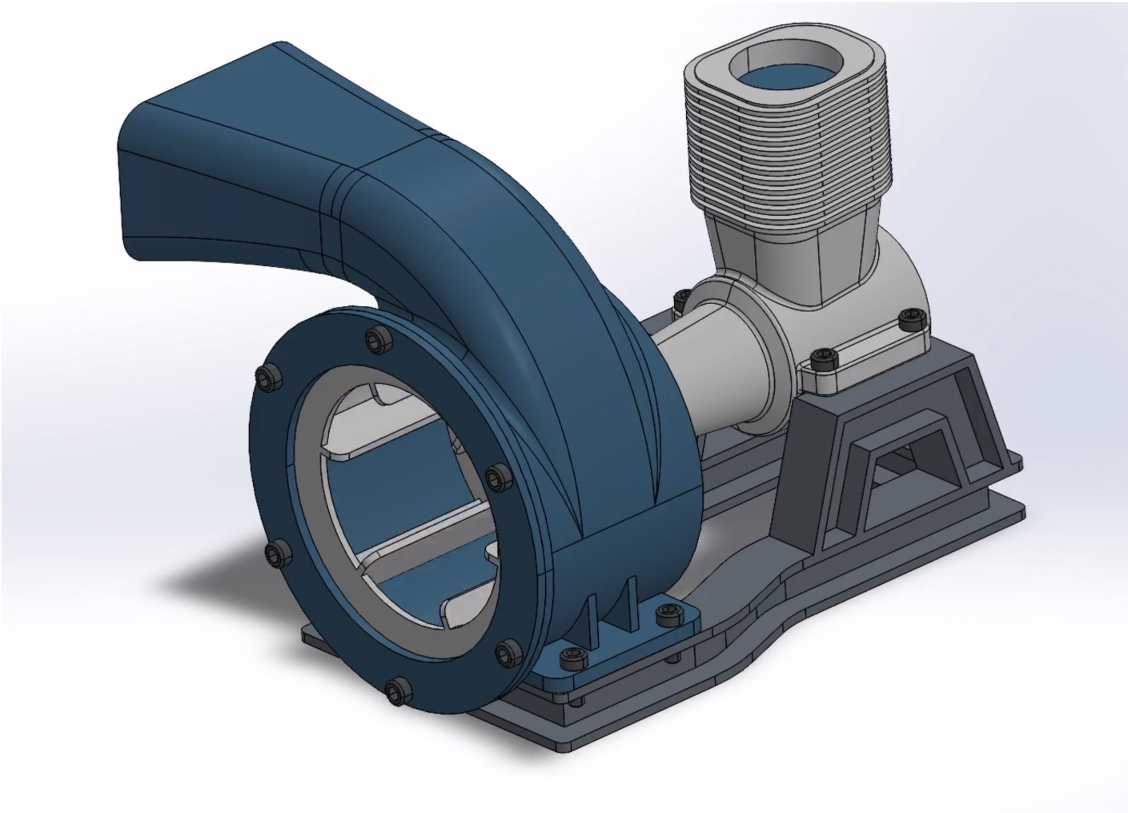
Assembly (40 points)



Transformation (60 points)

Given two disjoint curves $P(u)$ and $L(t)$, transform only $L(t)$ so that you achieve curvature continuity, C^2, at point $\mathbf{P_3}$ ($\mathbf{P_3} = \mathbf{L_0}$).

$\mathbf{P_0}$	(15,6)	$\mathbf{L_0}$	(9,9)
$\mathbf{P_1}$	(10,5)	$\mathbf{L_1}$	(4,2)
$\mathbf{P_2}$	(5,6)	$\mathbf{L_2}$	(2,2)
$\mathbf{P_3}$	(12,15)	$\mathbf{L_3}$	(0,7)

a) Find the given curve equations $P(u)$ and $L(t)$.

$$P(u) = \begin{bmatrix}12\\6\end{bmatrix} u^3 + \begin{bmatrix}0\\6\end{bmatrix} u^2 + \begin{bmatrix}-15\\-3\end{bmatrix} u + \begin{bmatrix}15\\6\end{bmatrix}, u \in [0,1]$$

$$L(t) = \begin{bmatrix}-3\\-2\end{bmatrix} t^3 + \begin{bmatrix}9\\21\end{bmatrix} t^2 + \begin{bmatrix}-15\\-21\end{bmatrix} t + \begin{bmatrix}9\\9\end{bmatrix}, t \in [0,1]$$

b) Find the tangent vectors at P_3 and L_0.

$$P'(1) = \begin{bmatrix}21\\27\end{bmatrix}, L'(0) = \begin{bmatrix}-15\\-21\end{bmatrix}$$

c) Describe the needed transformations, show the matrices for each of them, and find the final transformation matrix. Save the Excel sheet with your calculations in the assignment folder.

$$M_1 = \begin{bmatrix}1 & 0 & 0 & -9\\0 & 1 & 0 & -9\\0 & 0 & 1 & 0\\0 & 0 & 0 & 1\end{bmatrix}, \text{ move } \mathbf{L_0} \text{ to the origin}$$

$$M_2 = \begin{bmatrix}-\frac{21}{15} & 0 & 0 & 0\\0 & -\frac{27}{21} & 0 & 0\\0 & 0 & 1 & 0\\0 & 0 & 0 & 1\end{bmatrix}, \text{ scale to make the tangent vectors match}$$

$$M_3 = \begin{bmatrix}1 & 0 & 0 & 12\\0 & 1 & 0 & 15\\0 & 0 & 1 & 0\\0 & 0 & 0 & 1\end{bmatrix}, \text{ move the origin to } \mathbf{P_3}$$

$$[T] = M_3 M_2 M_1 = \begin{bmatrix}-1.40 & 0 & 0 & 24.60\\0 & -1.29 & 0 & 26.57\\0 & 0 & 1 & 0\\0 & 0 & 0 & 1\end{bmatrix}$$

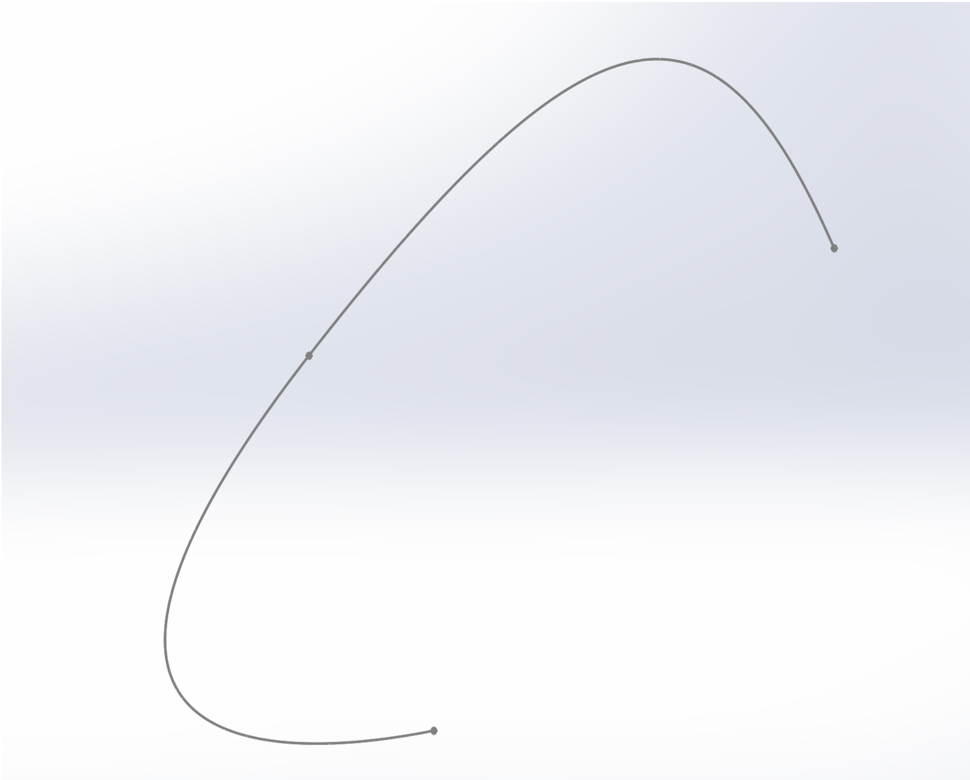
d) Find the parametric equation for the transformed curve.

We find the four control points of the new curve and calculate the parametric function.

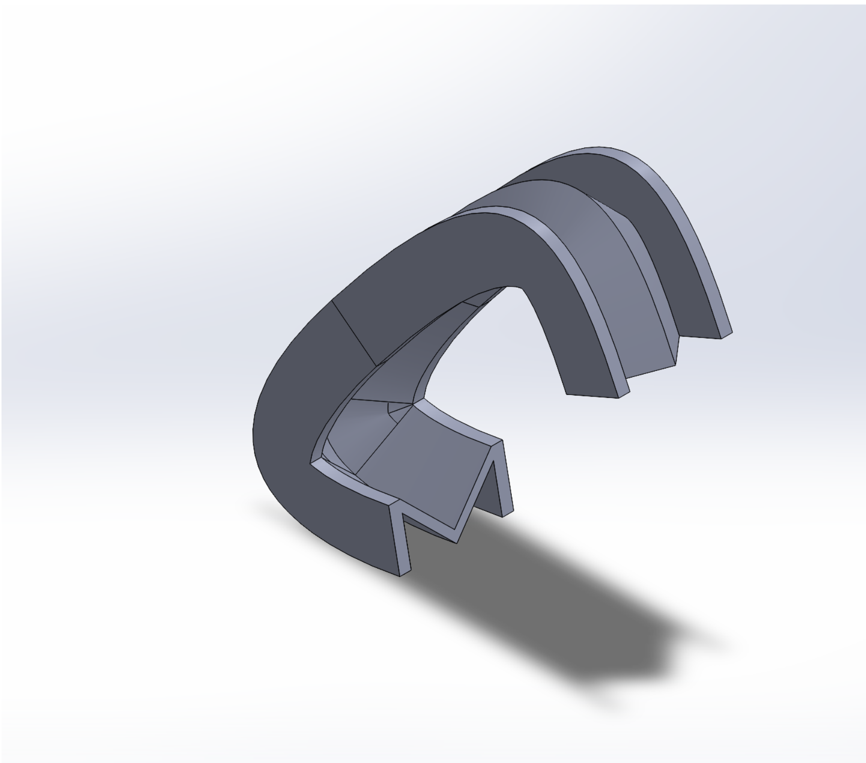
$$N_0 = \begin{bmatrix}12\\15\end{bmatrix}, N_1 = \begin{bmatrix}19\\24\end{bmatrix}, N_2 = \begin{bmatrix}21.8\\24\end{bmatrix}, N_3 = \begin{bmatrix}24.6\\17.57\end{bmatrix}$$

$$N(t) = \begin{bmatrix}4.2\\2.57\end{bmatrix} t^3 + \begin{bmatrix}-12.6\\-27\end{bmatrix} t^2 + \begin{bmatrix}21\\27\end{bmatrix} t + \begin{bmatrix}12\\15\end{bmatrix}, t \in [0,1]$$

e) Use the found equations to sketch the combined curve in SolidWorks.



f) Use the combined curve as a path and sweep your initial along the curve.



Light Bulb (10 bonus points)

Some sketches were not properly constrained, hence my model may differ from given model.