SCSJ 2273 PROGRAMMING FOR ENGINEERS — Semester II 2017-2018
Project 2 — Due: 31st May 2018

This is NOT a group project. While discussion with other students is encouraged, all work submitted for credit, however, must be your own. Any evidence of plagiarism or other forms of scholastic dishonesty will be grounds for a failing grade in the course.

Problem Statement

Consider a non-offset piston connected to a crank by means of a connecting rod. The governing mathematical equation for the system is

$$x = r\cos A + \sqrt{l^2 - r^2\sin^2 A}$$

where x is the position of piston pin from crank center, A is the crank angle from TDC (top dead center), l is the rod length and r is the crank radius, as shown in Figure 1.

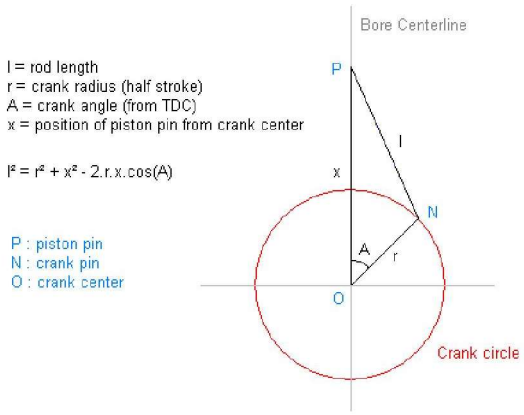

Figure 1: Geometric layout of piston pin, crank pin and crank center

The velocity with respect to the crank angle, in length per radian, of the piston is

$$x' = \frac{dx}{dA} = -r\sin A - \frac{r^2\sin A\cos A}{\sqrt{l^2 - r^2\sin^2 A}}$$

and the acceleration with respect to the crank angle in length per radian^2 is

$$x'' = \frac{d^2x}{dA^2} = -r\cos A - \frac{r^2(\cos^2 A - \sin^2 A)}{\sqrt{l^2 - r^2\sin^2 A}} - \frac{r^4(\cos^2 A\sin^2 A)}{\left(\sqrt{l^2 - r^2\sin^2 A}\right)^3}$$

Task

With the information given above,

1. Write an Octave program to calculate equation (1), (2) and (3) when l = 100 mm with r = 50 and 70 mm and for $-2\pi \le A \le 2\pi$. The results of the calculation must be written to an output file. The output file should contain information described in Figure 2. You do not need to include the < .. > as this is for the description of the columns for the output data.
2. Using the output file from part (1), use Octave to plot the position, angular velocity and angular acceleration with respect to crank angle. Sample plot is shown in Figure 3.

Please use these units for your plots: x in mm, x' in mm/rad, x" is mm/rad^2 and crank angle A in degrees.

		<For r = 50 mm>			<For r = 70 mm>		
<Angle, deg>	<Angle, rad>	<Position>	<Velocity>	<Acceleration>	<Position>	<Velocity>	<Acceleration>
-360	-6.283185	150.000000	-0.000000	-75.000000	170.000000	-0.000000	-119.000000
-359	-6.265732	149.988577	-1.308881	-74.980010	169.981876	2.076770	-118.970456
:	:	:	:	:	:	:	:
360	6.283185	150.000000	-0.000000	-75.000000	170.000000	-0.000000	-119.000000

Figure 2: Sample required data output file

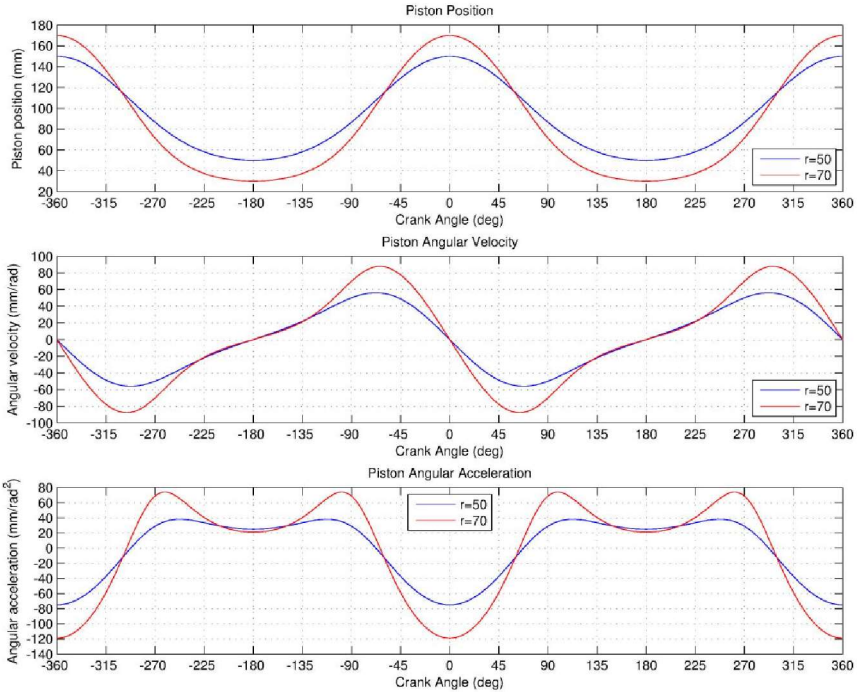

Figure 3: Sample required plots.

Project report submission

1. This project report must be presented in a standard technical report format. The content must include introduction, algorithm and flowchart, results (program output) and discussion including program verification, and conclusion.
2. Report is to be type-written and printed on A4-sized papers.
3. Fully commented source codes of the computer programs developed for the project must also be handed in, copied on to a CD and attached to the report. No mark will be given if the program softcopy is not submitted.
4. Please include the following statement in the first page of the project submission. No mark will be given if this statement is not included.

I, *full name,* hereby declare that this project submission is a product of my own effort. I acknowledge that academic disciplinary action can be taken if this submission is a result of plagiarism or other form of scholastic dishonesty.

Yours Truly,
Your signature and date

Figure 2: Sample required output file.