IECMA 2024 Conference
The 2nd International Electronic Conference on Machines and Applications
18–20 June 2024 | Online

Improving Internal Combustion Engine Performance through Inlet Valve Geometry and Spray Angle Optimization: Computational Fluid Dynamics Study

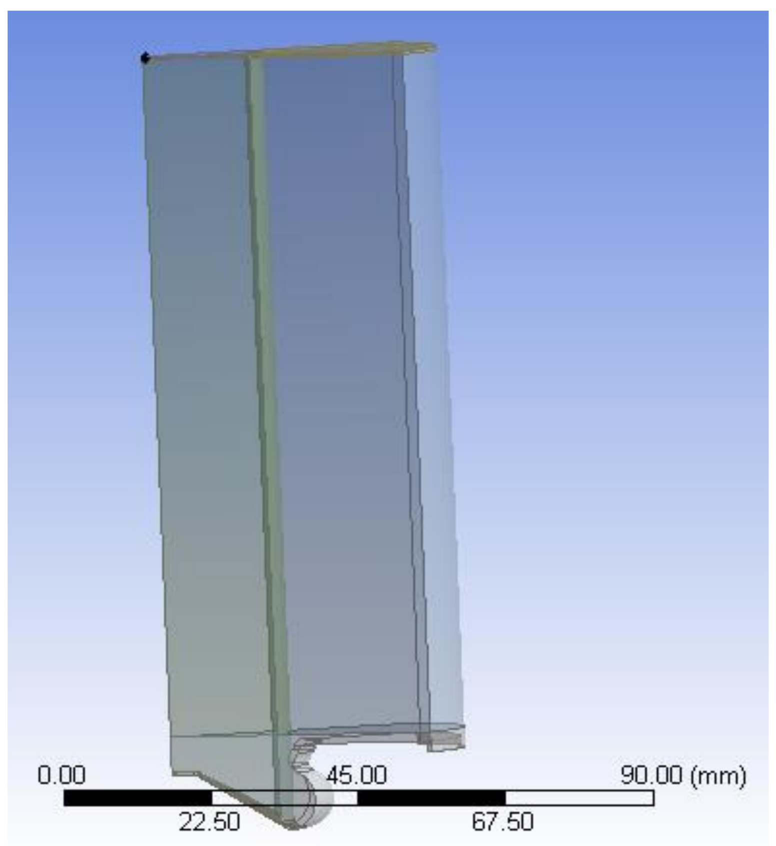
Muhammad Ahsan, Mian Noman
School of Chemical and Materials Engineering, National University of Sciences and Technology, Islamabad 44000, Pakistan

INTRODUCTION & AIM

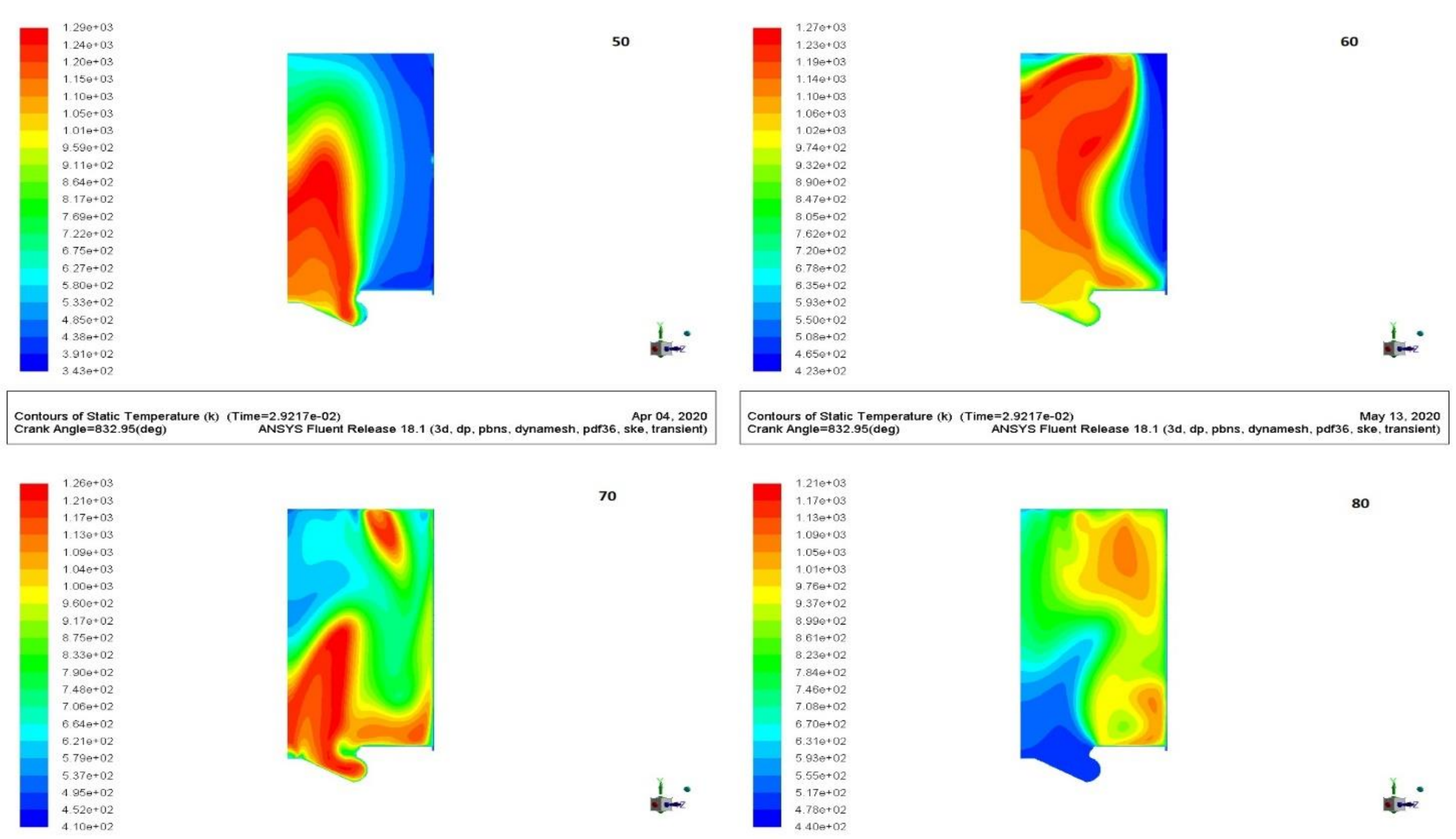
1. Internal combustion engines (ICEs) are the backbone of automotive and industrial machinery, playing a crucial role in global transportation and power generation.
   A key area of research in ICE performance enhancement is the optimization of inlet valve geometry and spray angle. The inlet valve's design significantly influences air-fuel mixture formation, combustion efficiency, and overall engine performance.
   Similarly, optimizing the spray angle can enhance fuel atomization and distribution within the combustion chamber, leading to more complete and efficient combustion.
2. The primary aim of this research is to enhance the performance of internal combustion engines by optimizing the inlet valve geometry and spray angle using Computational Fluid Dynamics (CFD). This involves:
   - Optimize the fuel injection Angle to increase the engine efficiency
   - Investigate the effect of spray angle on the performance of the engine
   - Reduce the emission from the engine.

METHODOLOGY

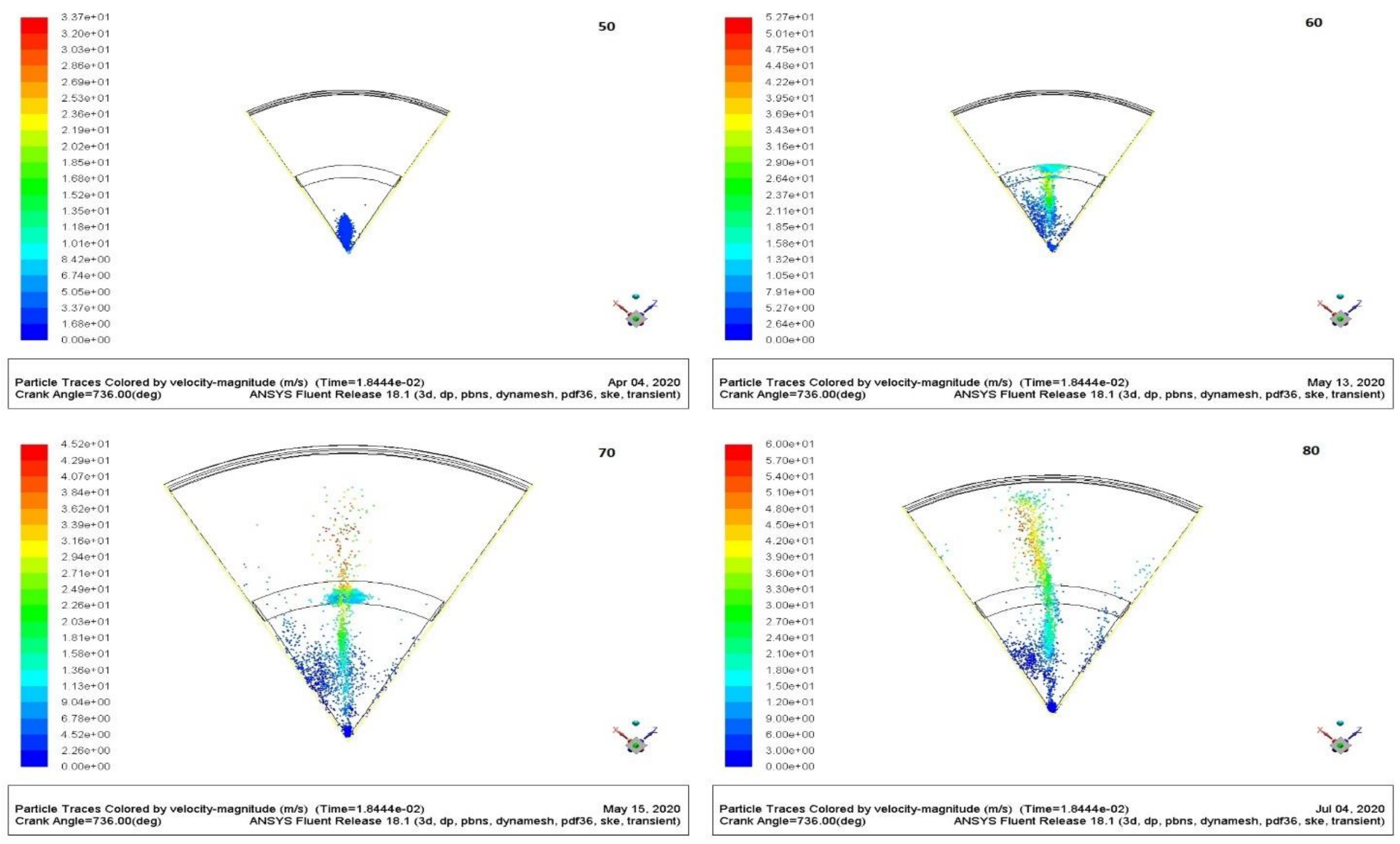
Geometrical Characteristics	
Combustion simulation type	Sector (60°)
Connecting rod length	165
Crank radius	55
Starting crank angle	570 ° (IVC)
End crank angle	833 ° (EVO)
Compression Ratio	15.75



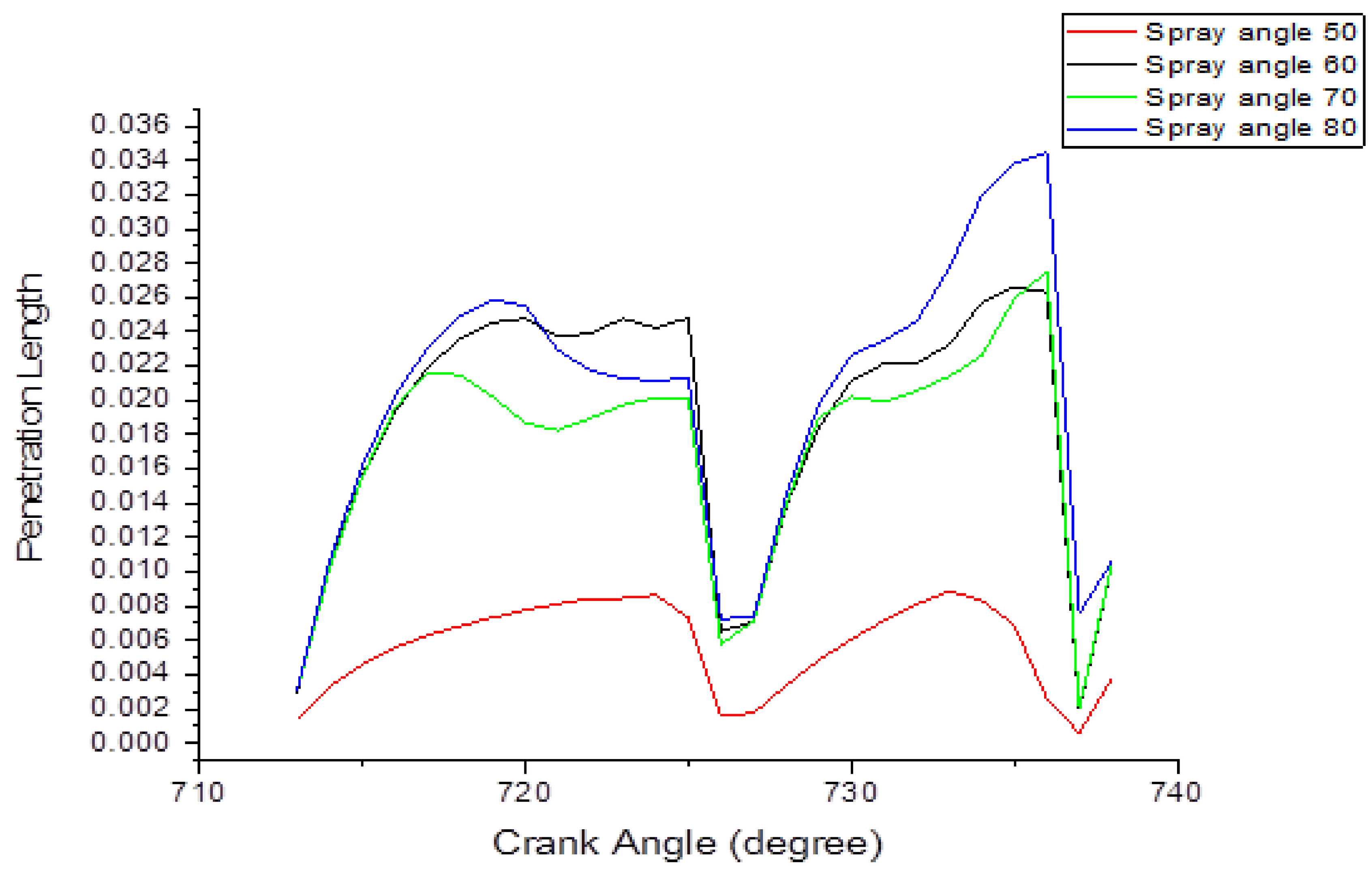
RESULTS & DISCUSSION



Contours of Static Temperature



Contours of Velocity Magnitude



Penetration Length VS Crank Angle

CONCLUSION

- Increasing the spray angle from 50° to 70° leads to a rise in cylinder pressure, but further increasing the angle beyond 70° causes a slight decrease in pressure.
- The lowest unburnt fuel is observed at a 70° spray angle, with higher unburnt fuel values at other angles, while fuel penetration and cylinder temperature increase with spray angles from 50° to 80°.

FUTURE WORK / REFERENCES

- Future research should focus on optimizing the spray angle around 70° to balance cylinder pressure, minimize unburnt fuel, and achieve efficient fuel penetration and temperature control.
- Additionally, investigating the effects of spray angles in finer increments near 70° may provide more precise data for improving engine performance and emissions.