DETONATION LIMITS IN ROUGH TUBES

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INTRODUCTION
My research is to study the limits of gaseous detonations propagating in round, rough walled tubes. This will be achieved by systematically varying experimental parameters in order to determine their individual influence on the propagation of the detonation. It will allow for a theoretical detonation model to be developed from the experimental results.

BACKGROUND
What is a detonation?
It is a supersonic combustion wave which is comprised of a leading shock front followed by an induction zone and reaction zone. The wave is characterized by:
- Reactants → Products
- Chemical energy → Thermal and kinetic energy
- Large changes in thermodynamic states

What is a detonation limit?
It is a range in which detonations have been observed in laboratory and field experiments. It is dependant on a specific variable e.g. pressure or mixture composition. When the detonation no longer propagates, the limit has been found.

What is a rough tube?
It is a tube in which the inner walls are no longer smooth. There are now obstacles present as the detonation propagates through the tube. This is achieved by placing a coil inside the tube.

EXPERIMENTAL SET-UP

Driver Section
- Driver section length: 3 feet
- Igniter provides energy to initiate detonation
- Driver mixture (more sensitive) and Shelkin spiral used to ensure a fully developed detonation in the test mixture

Detonation Tube
- Experiments performed under vacuum conditions
- Manifold consisting of Swagelok connections and valves used to control experiment
- Pressure transducers and digital meters to obtain desired vacuum and pressure readings

EXPERIMENTAL PARAMETERS
- Pressure
- Coil diameter
- Coil pitch
- Test mixture
- Tube diameter

DIAGNOSTICS
- Photoprobes for velocity measurements
- Streak photography

CONCLUSION

The next step to this research is to perform the experiment and collect the relevant data. It is important to understand the role of each of the different parameters and how they affect the detonation limit. Ideally, a correlation between the amount of roughness and the detonation limit will be determined. The results can also be compared to similar experiments performed in smooth walled tubes. This can help explain the mechanism that is responsible for the propagation of a detonation wave.