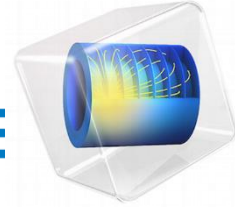


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# **Design of a Self-Recharging Untethered Mobile Inspection Tool inside a Pipeline**

**Wadie R. Chalgham**

University of Louisiana at Lafayette

10/06/2016

# OUTLINE

- **Statement of Problem: Why Pipeline Inspection?**
- **Objectives and scope**
- **Model Design**
- **Simulation Results**
- **Sensitivity Analysis**
- **Conclusions**

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# Why Pipeline Inspection?

- High environmental, financial and human risks due to leaks
- Every day leaking pipes lose more than 7 billion gallons of clean drinking water
  - \$11 billion in loss per year from water leaks only.
- In 2013 alone, 623 gas and hazardous liquid pipeline incidents
  - 10 fatalities, 47 injuries and \$336 million in property damage.

# Why Pipeline Inspection?



*72-inch Pipe failure causing more than 100 homes to flood on 2009, Baltimore, MD*

# Why Pipeline Inspection?



*66-inch Pipe water main failure on 2008, Interstate 25, Denver, Colorado*

# OUTLINE

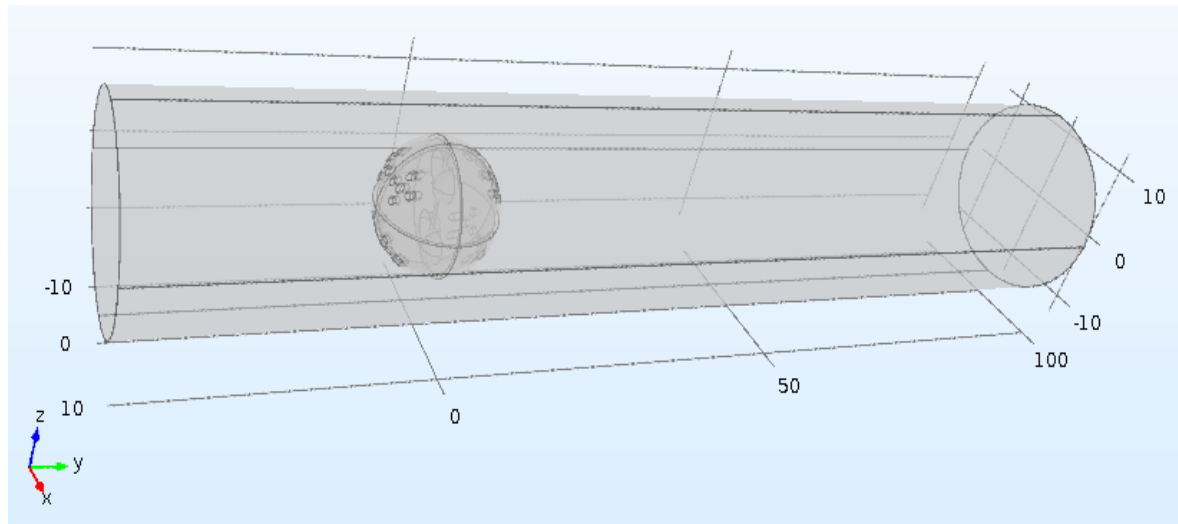
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# Objectives and Scope

→ Innovative Design of a Self-Recharging Mobile Inspection Tool

**Numerical study Goal:**

Energy gained by the rotation of the blades inside the ball

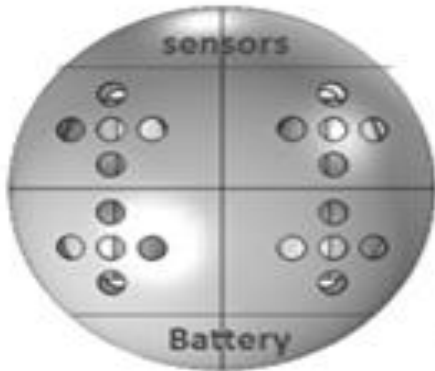




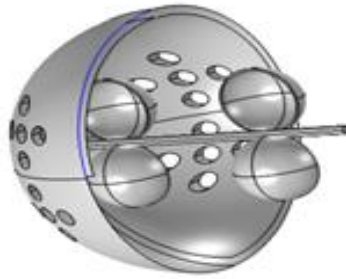
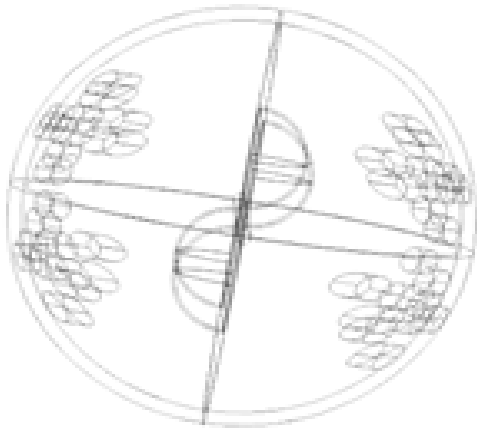
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# Model Design



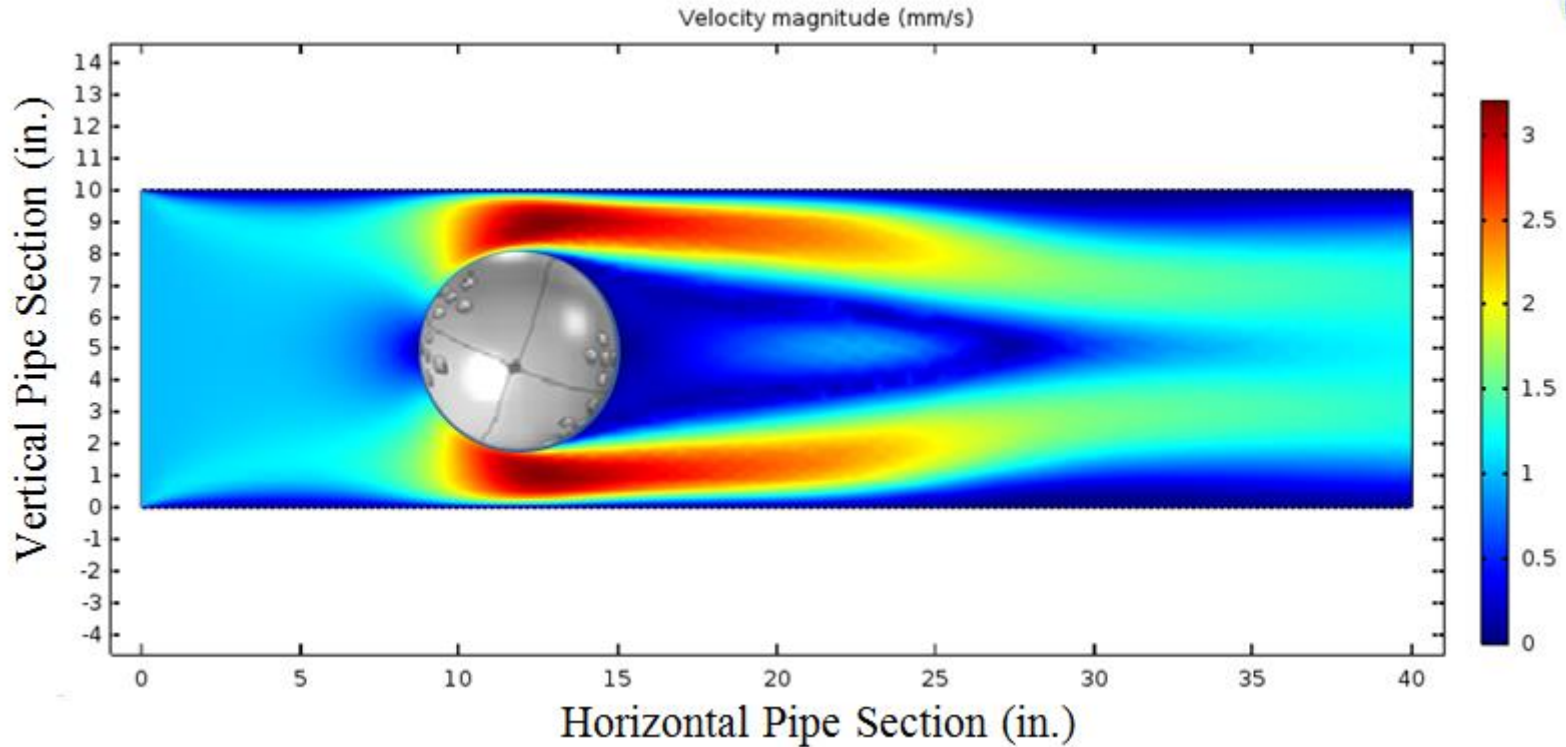
# Model Design



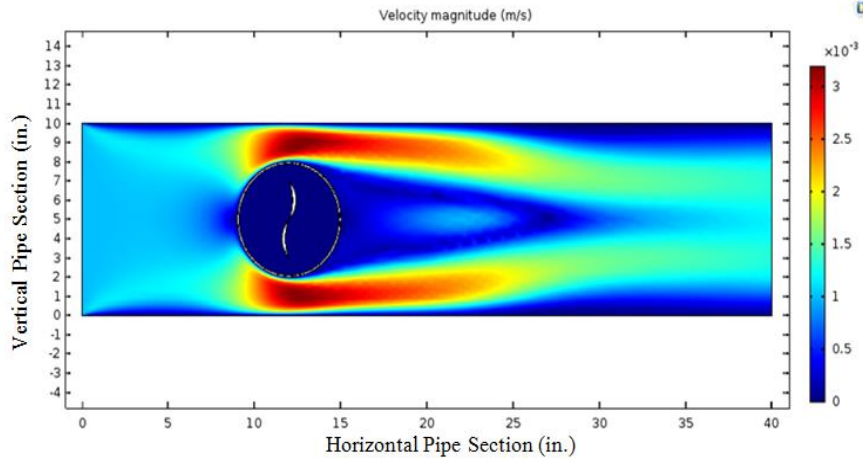
# OUTLINE

- **Statement of Problem: Why Pipeline Inspection?**
- **Objectives and scope**
- **Numerical Model**
- **Simulation Results**
- **Sensitivity Analysis on Leak Noise Propagation**
- **Conclusions**
- **Future Work**

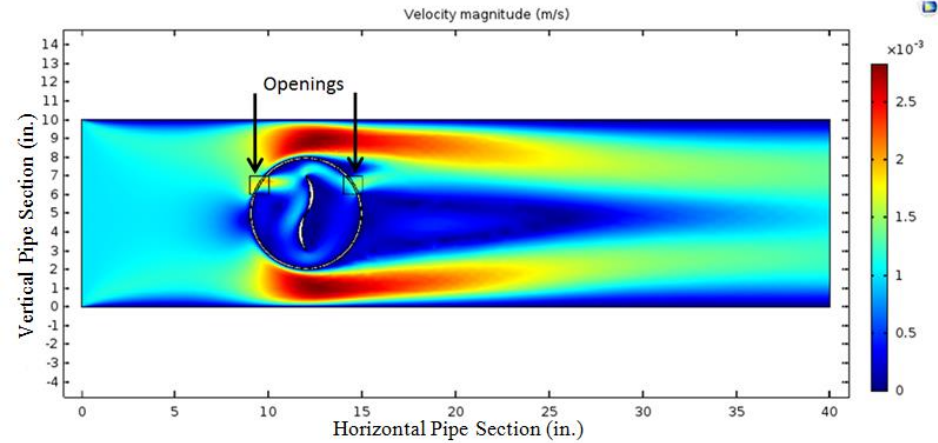
# Velocity Results



# Velocity Results

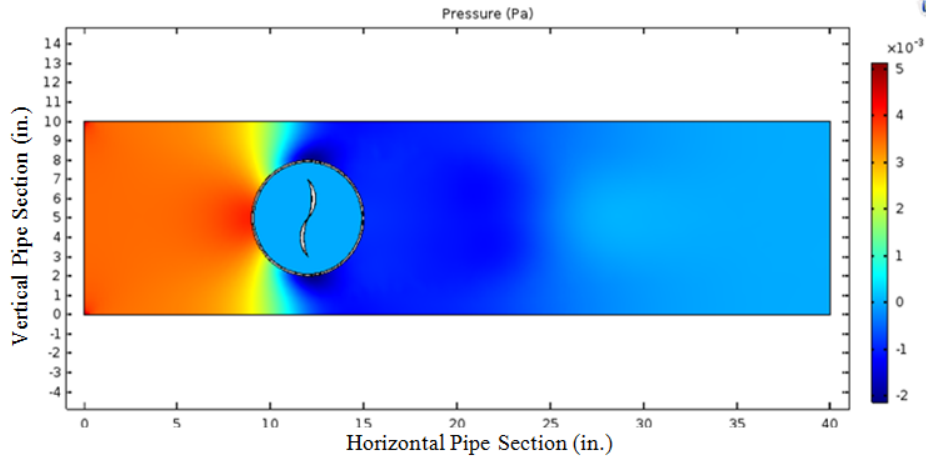


Velocity Propagation  
Without Openings

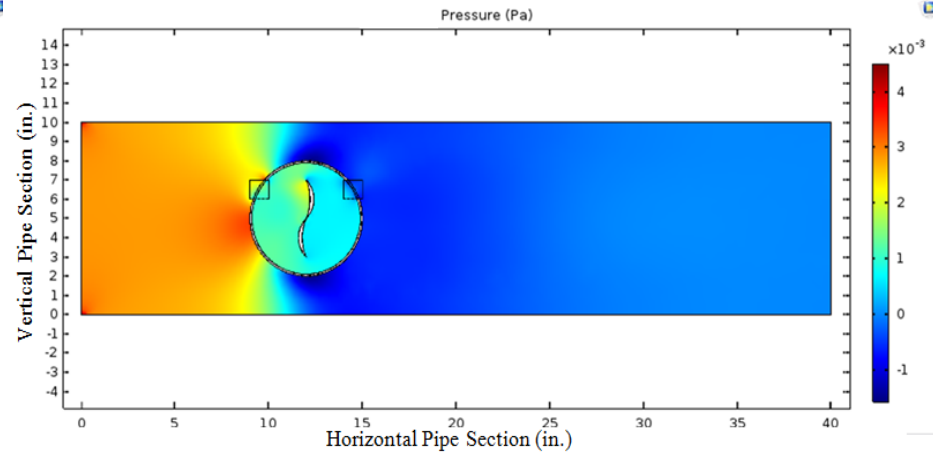


Velocity Propagation  
With Openings

# Pressure Results



Pressure Propagation  
Without Openings



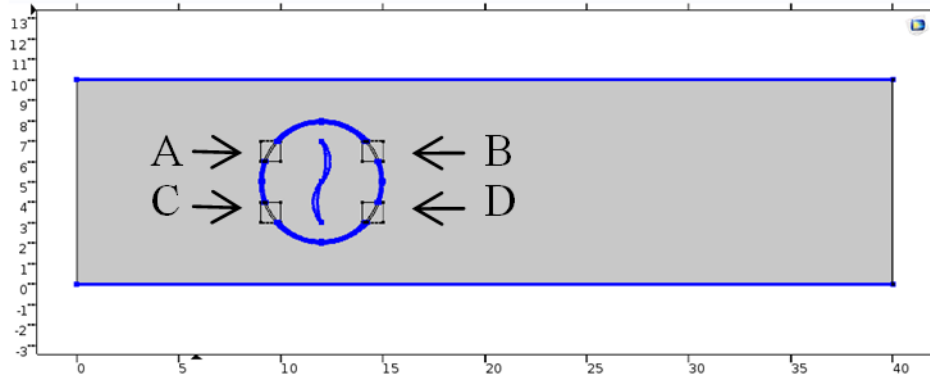
Pressure Propagation  
With Openings

# OUTLINE

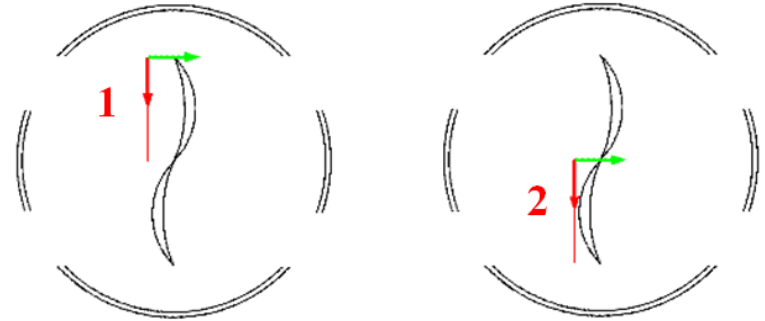
- **Statement of Problem: Why Pipeline Inspection?**
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# Sensitivity Analysis

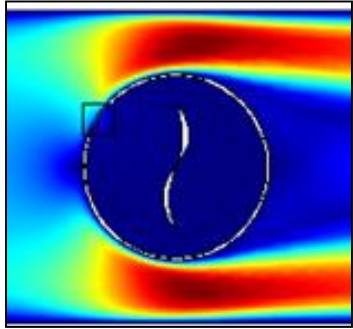


Four Openings Locations

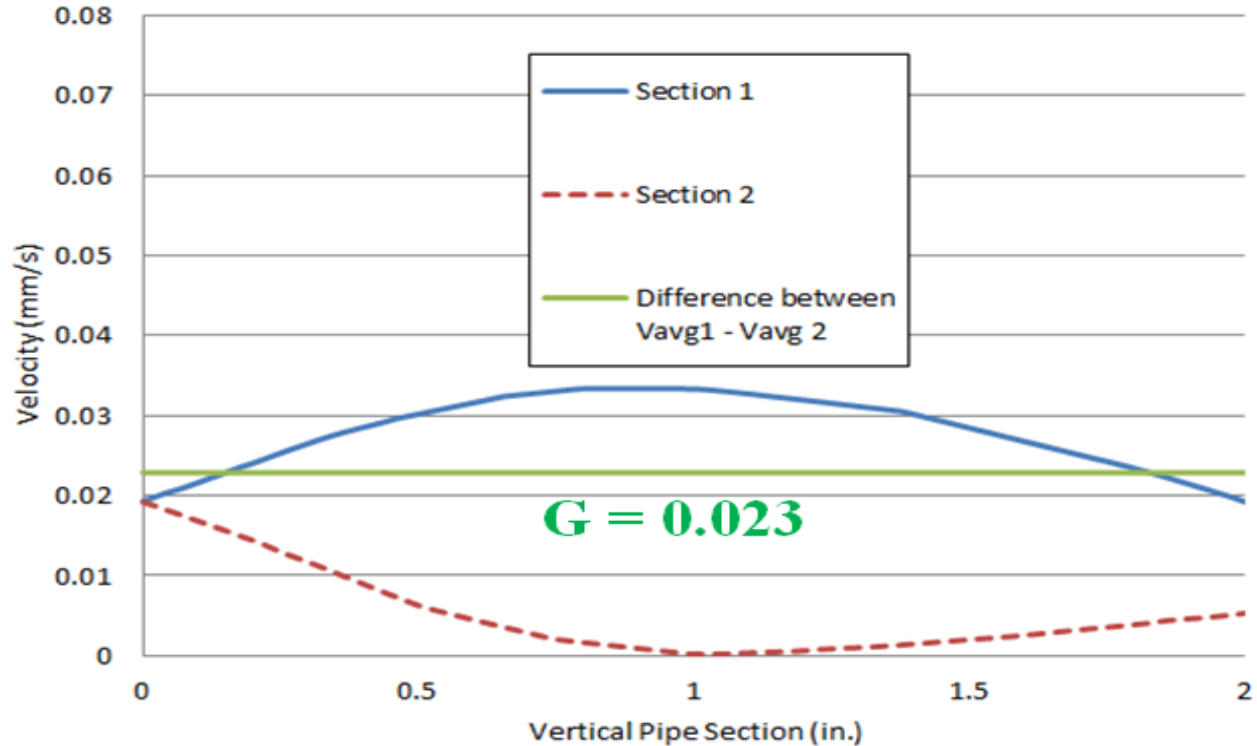


Location of Vertical Sections

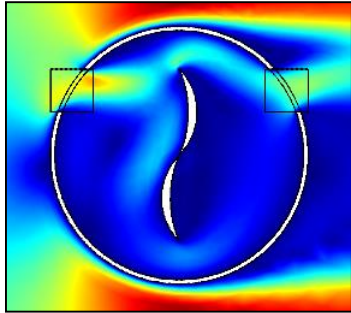
# Velocity Results with One Opening



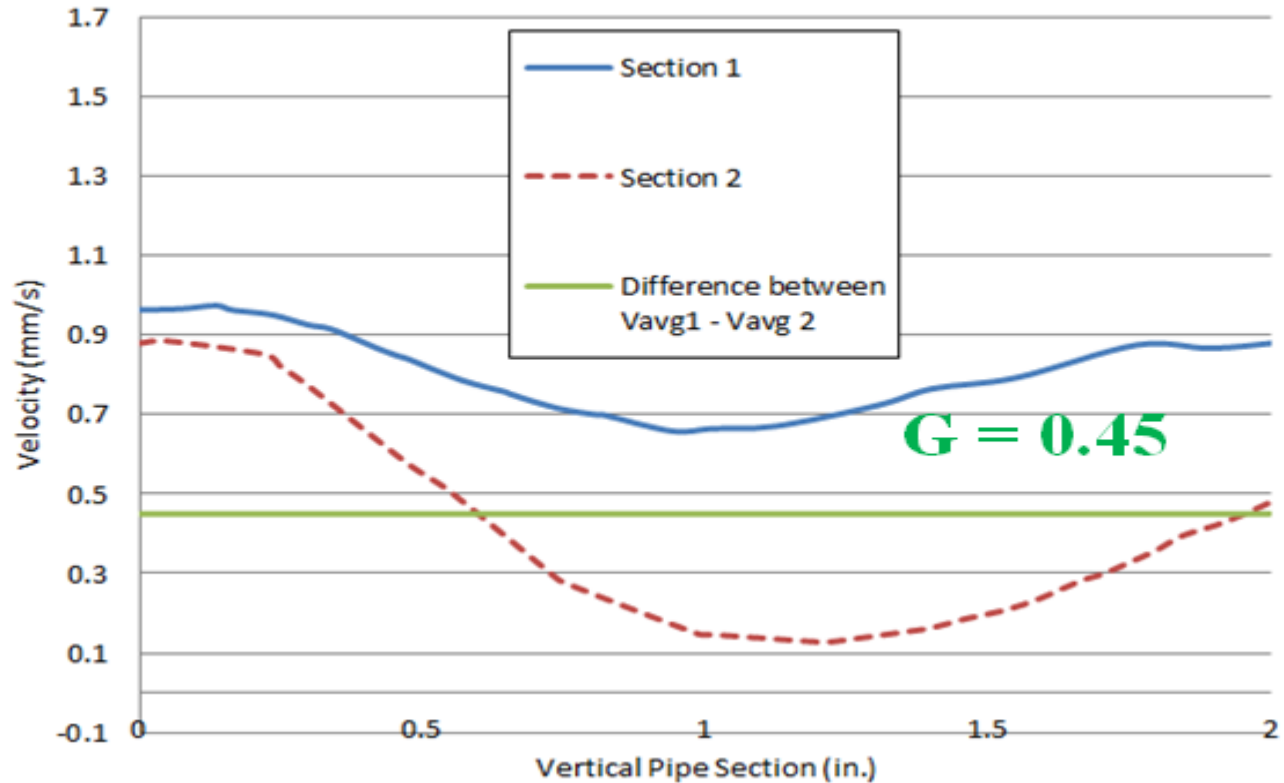
Opening A



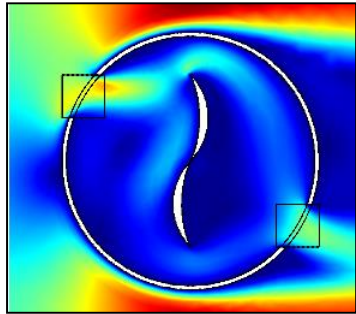
# Velocity Results with Two Openings



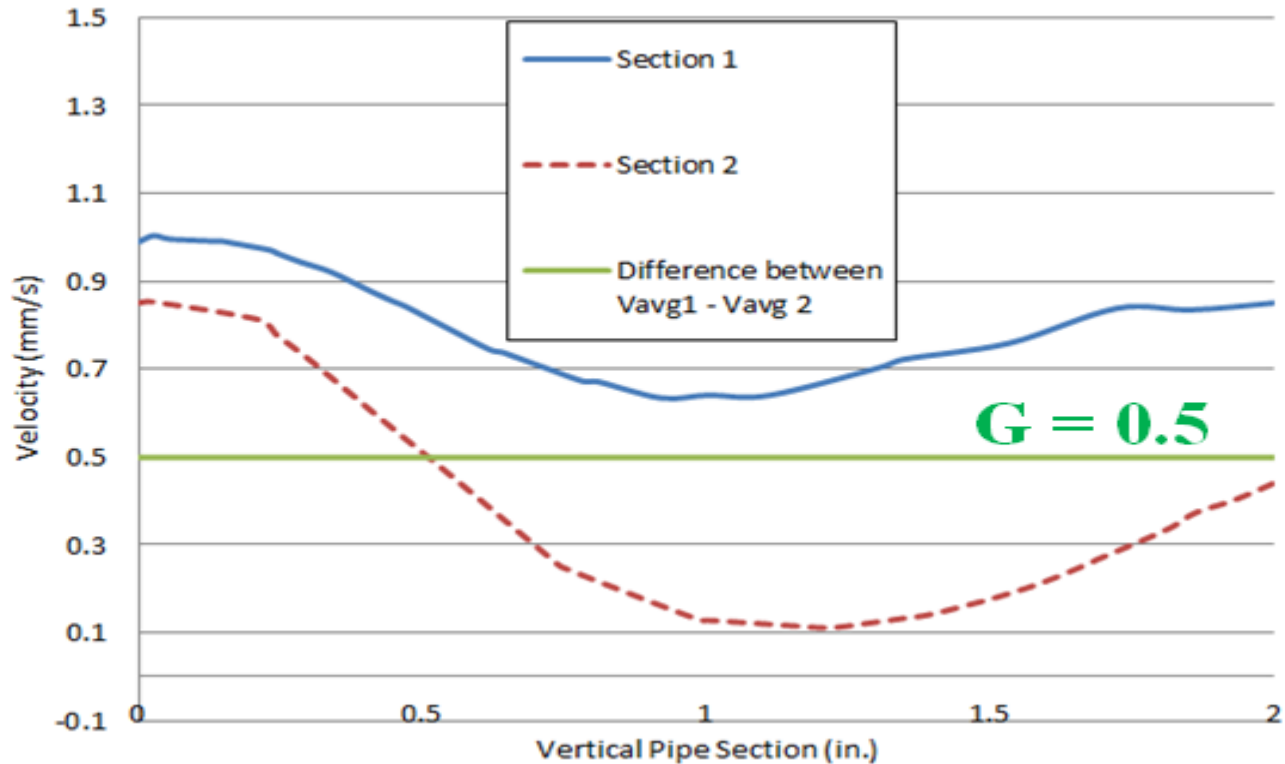
Openings A and B



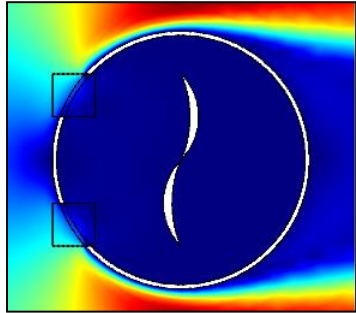
# Velocity Results with Two Openings



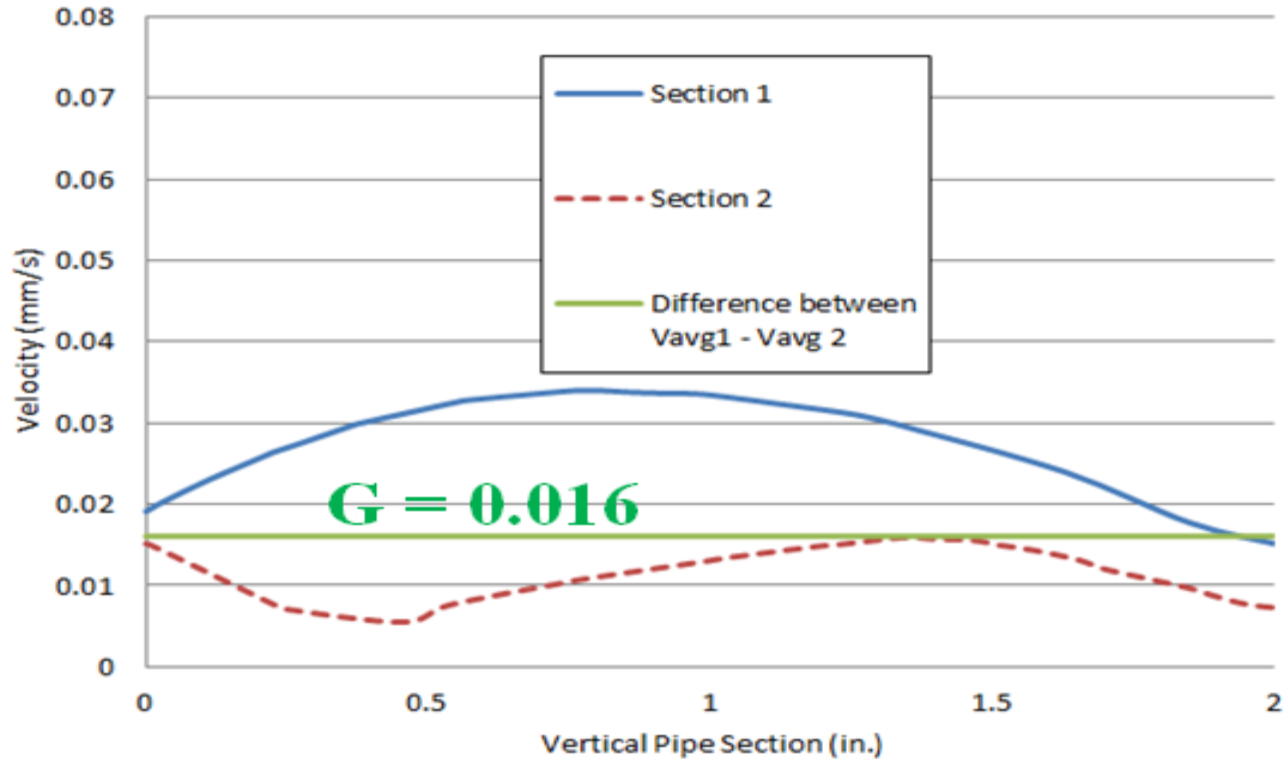
Openings A and D



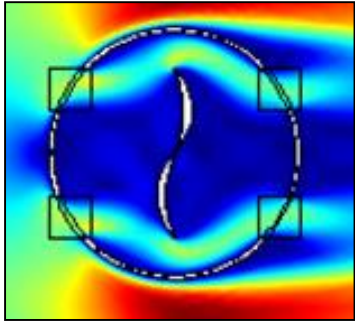
# Velocity Results with Two Openings



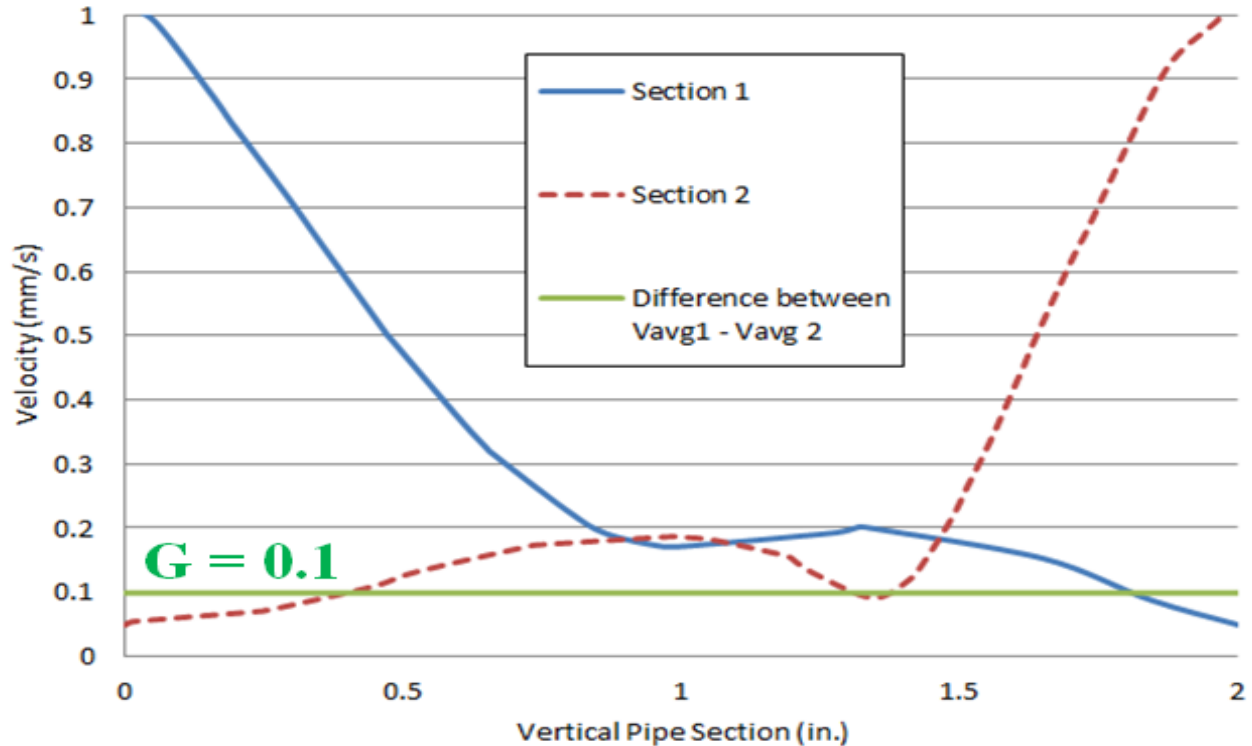
Openings A and C



# Velocity Results with 4 Openings



Openings A, B,  
C and D

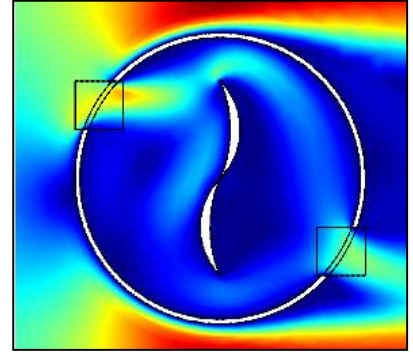


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# Conclusions

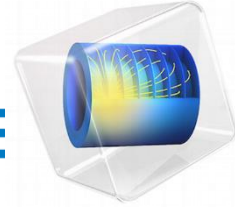
→ Optimal Design consists of 2 Openings: A and D



- This design provides maximal rotational velocity for the blades
- The energy gained from the blades rotation will recharge the battery embedded inside the spherical ball



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**Thank you**  
**Any Questions?**

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