# Non-Intrusive Drop-in Sewer Monitoring

Choose Ohio First

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## Abstract

This research aims to investigate a new drop-in system for sewer monitors to reduce the challenges that arise from traditional installations. Currently, physical access to the sewer infrastructure is needed which heightens both operational danger and financial burdens. This newly proposed approach would eliminate the need for personnel to enter sewer systems with drop-in technology that would coincide with safer and more efficient installation. Using simulations under ideal conditions, this research would collect valuable data which would allow for more practical implementation to improve our current sewer monitoring processes.

## Introduction

Civil engineers specializing in hydraulics manage our complex network of sewer systems. When faced with issues or renovations for existing infrastructure, various factors must affect sewer usage such as rainfall patterns, individual water consumption, and industrial water usage.

Currently gathering data from a specific sewer line entails a cumbersome process. A team must go to a site, potentially disrupting traffic by closing lanes, then descend into the sewer to install a flow monitoring device on the specified sewer line. The device installed has an electronic that measures velocity, depth, pressure, and flow.

To lower costs, enhance safety, efficiency, and ease of installation, we propose a drop-in system. This device would use its own weight to keep it in place to dangle in the manhole. This device would be made of an aluminum alloy in order to keep it lightweight and would not rust. To keep it in place, a hard rubber with tread would resist the manhole walls.

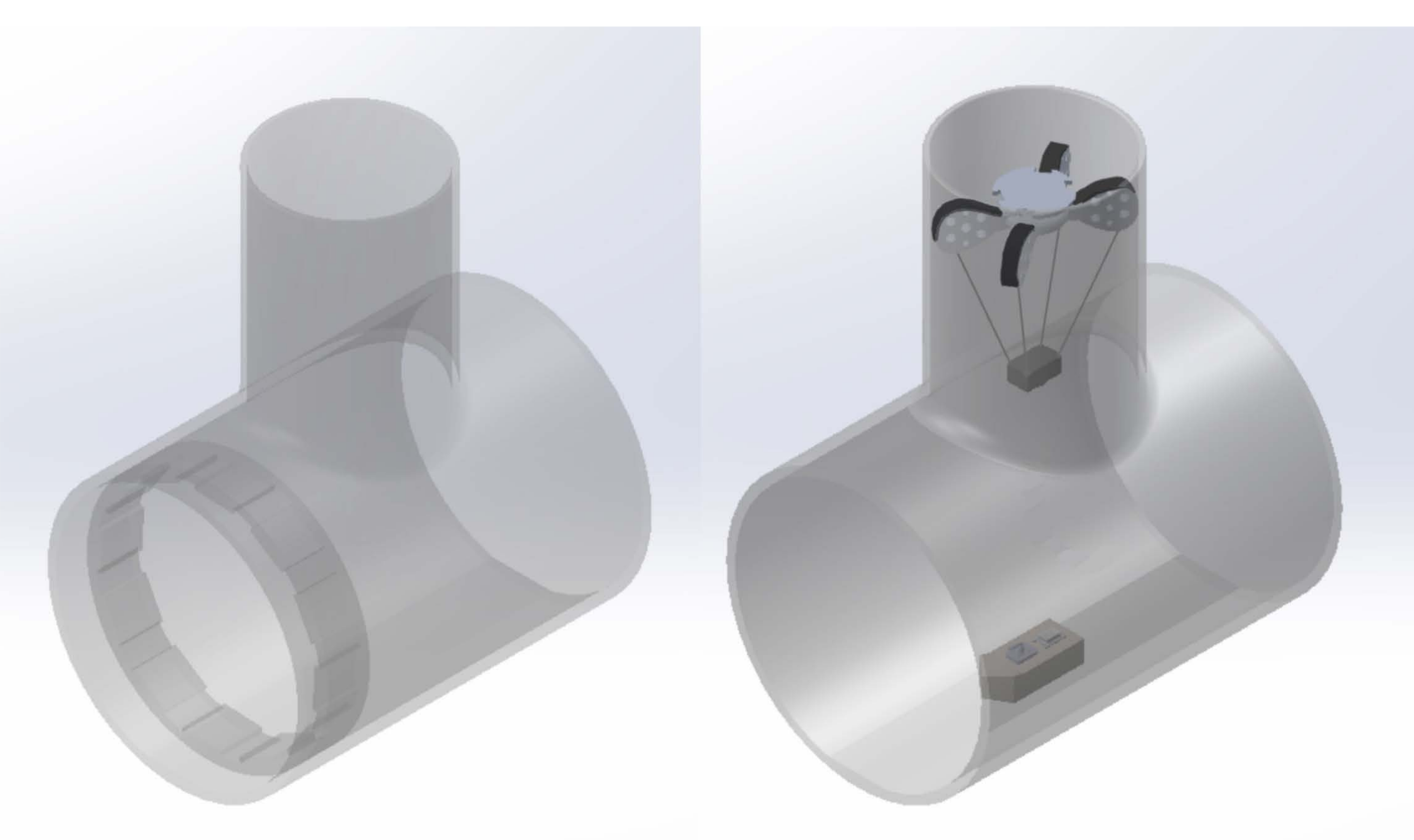

Figure 1 - 3D models of current design (left) compared to proposed design (right) composed in SolidWorks

## Methods

The inspiration for our design is based on rock climbing cams which uses tension between itself and surfaces to keep it put. Our device would have treaded rubber to keep it in place from the normal force of its own weight, and the legs could be moved around the fixed ring. It could be installed by lowering both devices separately with a pulley. The electronic devices would remain the same as the current design but with a mechanical backup. A pitot tube would be attached to the bottom device in case the lasers were to fail.

Two 3D models were made in SolidWorks, one of the current sewer monitoring method (control) and the second being our concept (experimental). We ran a flow simulation to determine the observer effect that each had on the flow it was observing. Both were put in the same sewer environment and had the initial inlet with a velocity of 1.5 m/s on the front plane.

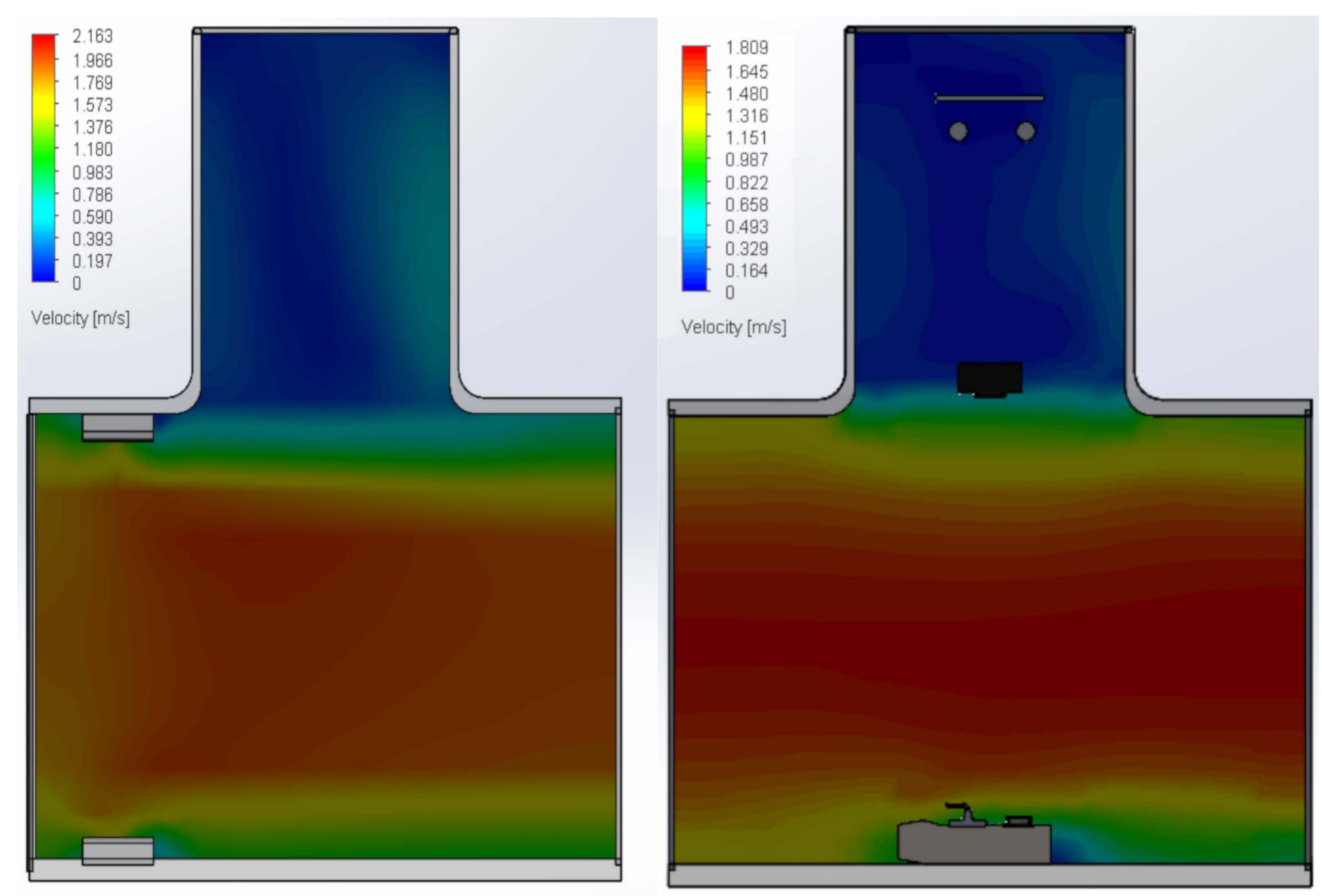


Figure 2 - Flow simulations ran with 3D models to determine observer effect

## Results

| Velocity Drop-off Comparison | | |
|---|---|---|
| Control | Invert | 48.03% |
| | Crown | 61.52% |
| Experimental | Pitot | 14.36% |
| | Anchor | 58.93% |

Grapple specifications
- Material: Aluminum Alloy
- Strength: Can carry any device under 16 tons
- Benefits: Reduced weight, enhanced durability

Anchor specifications
- Material: Tungsten
- Benefits: Dense, weight enhancement
- Potential Issues: Costly and brittle
    - Backup Option: Stainless Steel

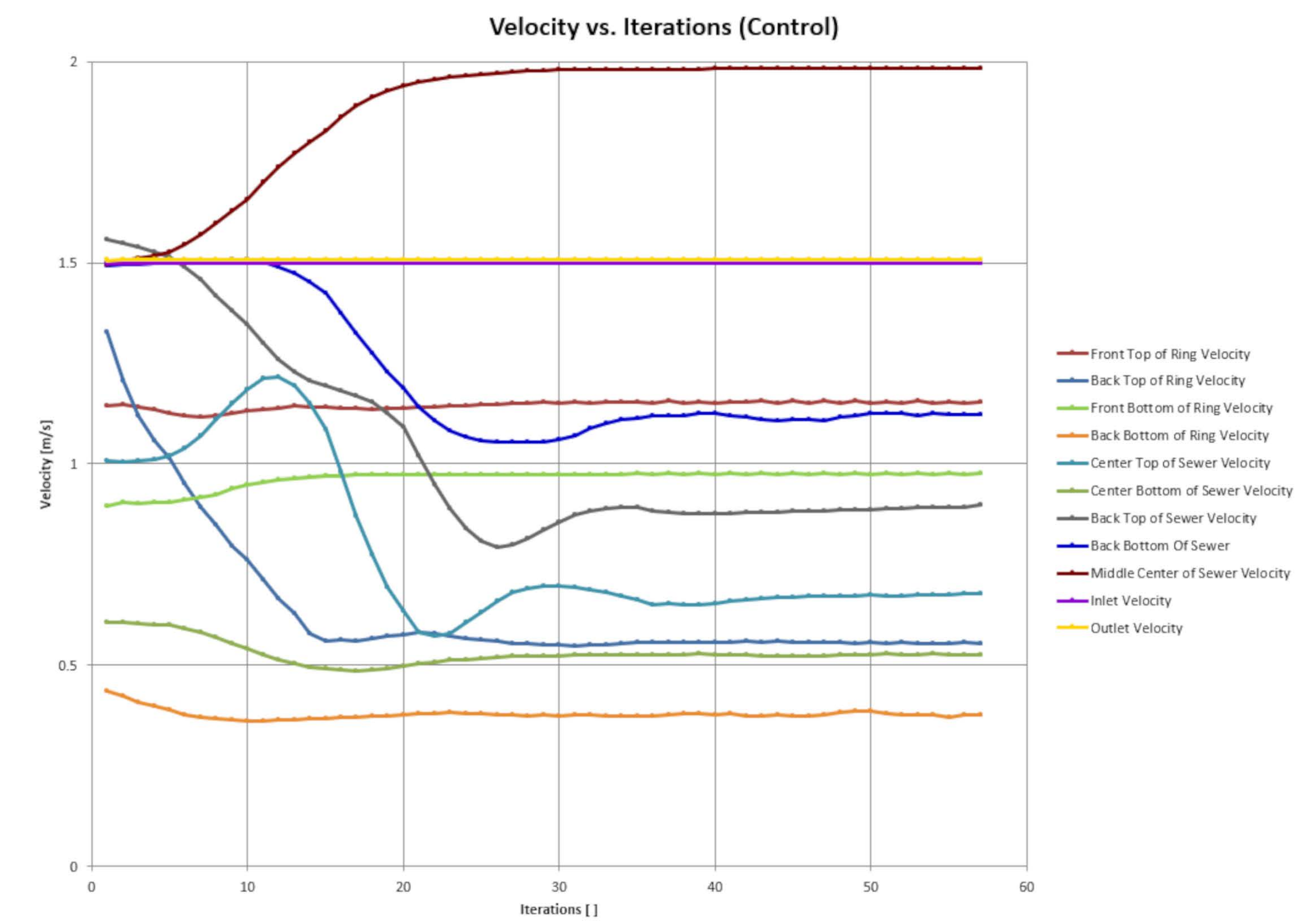


Figure 3 - Various velocities vs iterations at certain points of control

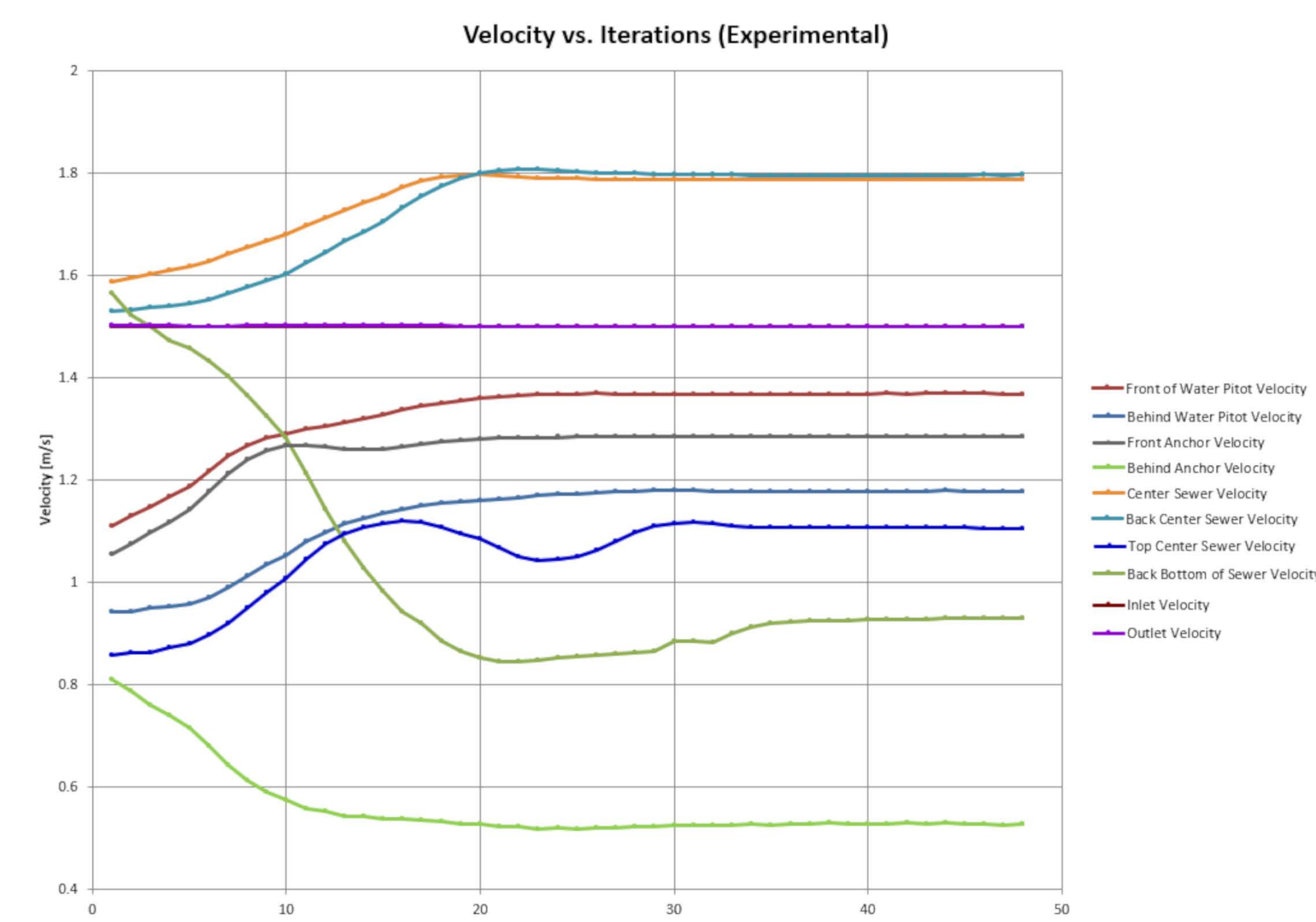


Figure 4 - Various velocities vs iterations at certain points of experimental

## Conclusion

Civil engineers managing sewer systems face many challenges when collecting data using flow monitoring, but this can be solved with a mechanical engineering solution. To overcome these issues, we propose a drop-in system that would enhance safety, efficiency, and cost-effectiveness.

Inspired by rock climbing cams, our innovative design utilizes its own weight to keep it secure for installation which eliminates the need for labor-intensive installations. Through SolidWorks simulations and material analysis, we have validated the theoretical effectiveness, showcasing the minimal velocity drop-off and structural integrity. This advancement offers a promising solution for our current sewer monitoring problems.