Wildland Firefighting Robot (FiGo)
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Abstract
With the increasing severity of wildfires across the Western United States, robots can fill the gap in manpower needed to combat these fires. Our focus was to design and build a robot to help alleviate this lack of manpower in the Wildland Urban Interface (WUI) of California.

Our robot uses a plow to simulate the removal of flammable material on the ground to expose the mineral soil. We developed two subsystems to control the plow horizontally and vertically. Our robot is driven via teleoperation or autonomously following flags. The goal of this project is to create a scaled robot that will lay the groundwork for effective autonomous indirect fireline construction.

Preliminary Study
We used two Zumos 344s to conduct preliminary tests on:
- Plow design
- Locomotion on rough terrain
- Testing terrain (soil and sand)

Key takeaways:
- Lead screw design confirmed in moving flow horizontally
- More effective plow mount placement for moment applied
- Added concave top curve on plow to stop overflow of sand onto robot
- Determined need for added weight due to oscillation when plowing

Plow Design
- Horizontal Plow Actuation:
  - Lead screw design
  - Non-backdrivable
- Vertical Plow Actuation:
  - Linear actuator to accommodate the plow arm moving upwards and downwards
  - Range of motion ±15 degree

Future Work
With our scaled robot, FiGo:
- Testing with different plow designs and modular front-end components (e.g., blades, mulcher, trencher, etc.)
- Navigating based on a predetermined GPS route and better vision processing
- Adaptive response based on terrain
- Expanding operation for other tasks (e.g., ash pit detection, UAVs for mapping, patrol routes, etc.)

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- FiGo & Starburst

Revisions:
- Scale by robot weight (5:1) instead of robot width (3:1)
- Fireline depth reduced from 5 cm to 2.5 cm
- Flat blade design
- Towing instead of pushing

Testing Results
Averaenge Length Plowed

Testing Automation
- Why Flag Following? Uses of flags to mark fireline: improvement in efficiency

Testing Terrain (Soil & Sand)
- Full Scale: 100cm W x 15cm D,
- Figo: 30cm W x 5cm D
- Original Blade Design:
  - Robot stalled often while trying to start plowing
  - Electrical damage from stalls prevented by fuses
  - Plow continued to dig deeper with forward motion

Testing Pipeline (cv2)
- Camera Snapshot
- Why Flag Following?
- Uses of flags to mark fireline: improvement in efficiency

Testing Results
Average Length Plowed

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Testing Automation
- Why Flag Following?
- Uses of flags to mark fireline: improvement in efficiency