Adaptative Friction Shock Absorbers and Reverse Thrust for Fast Multirotor Landing on Inclined Surfaces

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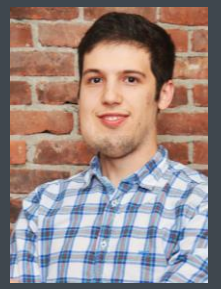
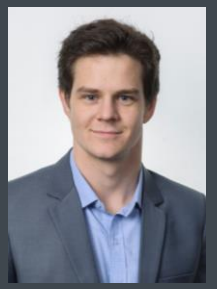
Authors



John Bass



Isaac Tunney

Prof. Alexis Lussier Desbiens

Motivation

In real life, landing surfaces are not often horizontal...

[1]

[2]

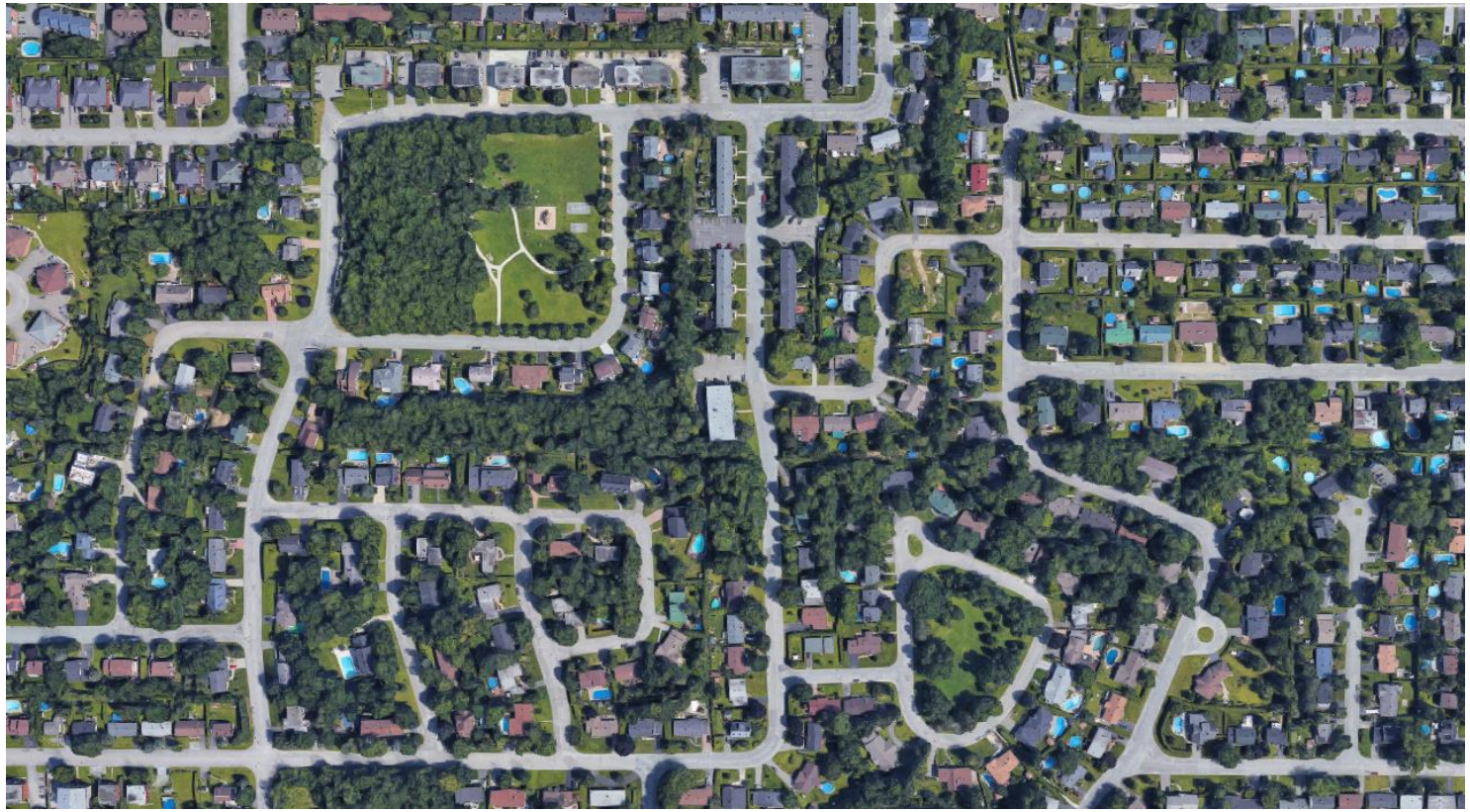
[3]

[1] metalroofing.com
[2] safehavenmarineold.com
[3] hydratrek.com

Motivation

Rooftops:

- Very common
- Clear of obstacles
- Inclinations mostly under 60°



[4]

[4] maps.google.com

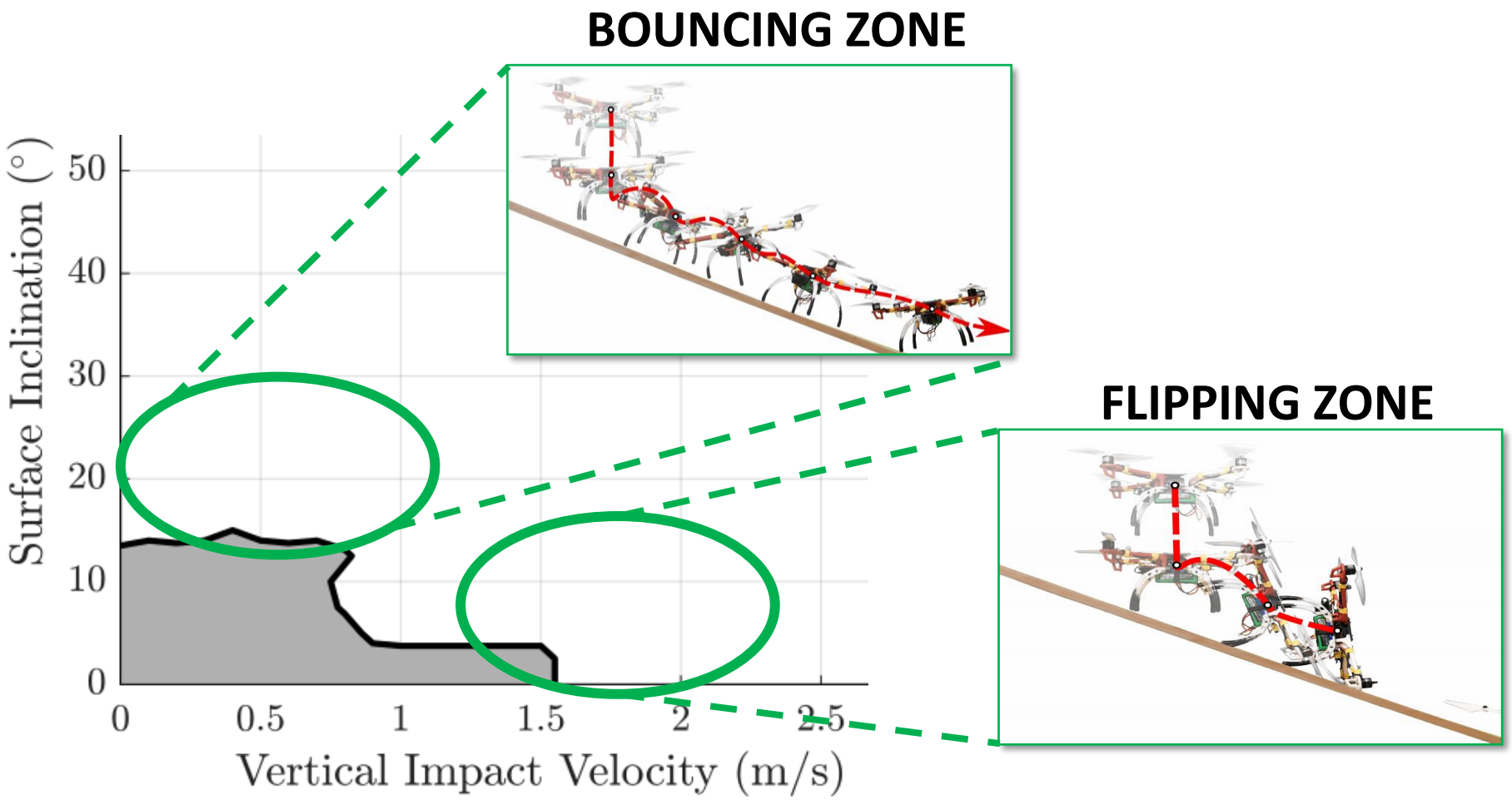
Motivation

Landing at high speeds on slopes is not an easy task!

Slow Landing

Fast Landing

Motivation


BOUNCING ZONE
FLIPPING ZONE
Surface Inclination (°)
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
Vertical Impact Velocity (m/s)

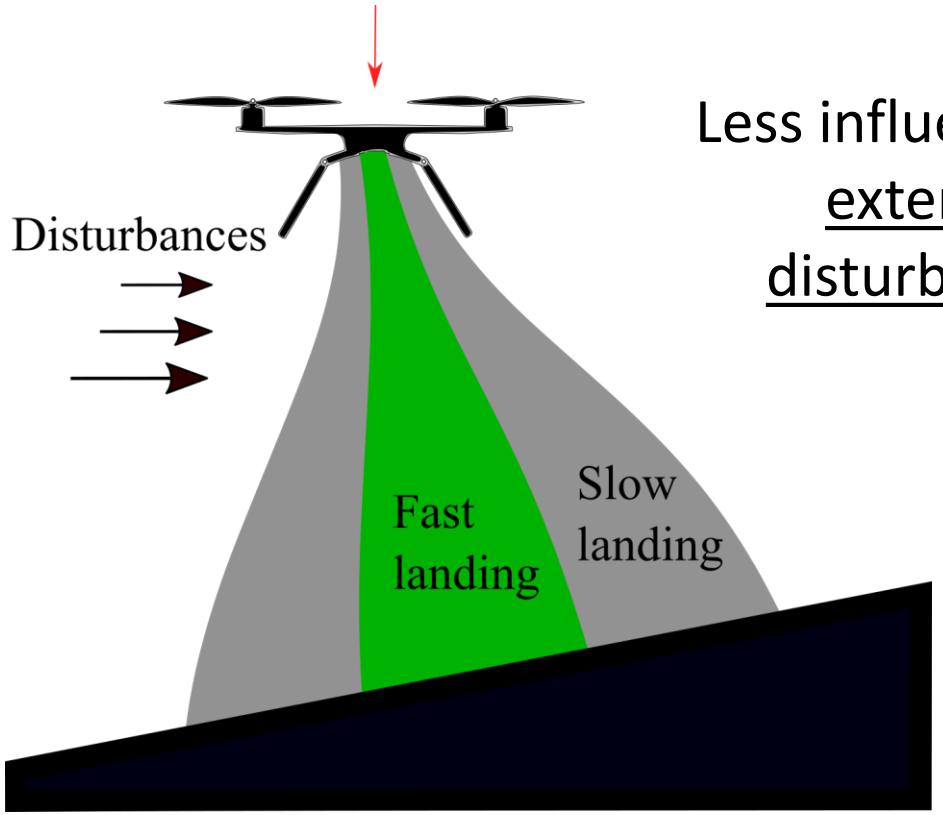
Method

Global Strategy

Goal

Landing fast

Landing on steep slopes



Less influenced by <u>external disturbances</u>

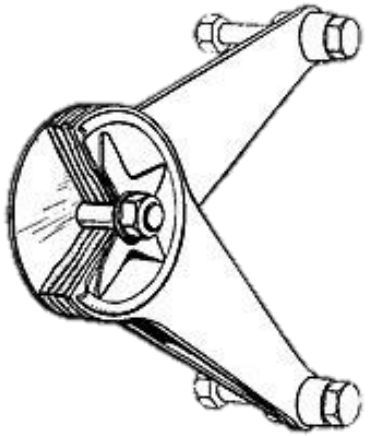
Wider <u>range of conditions</u>

Method

Global Strategy

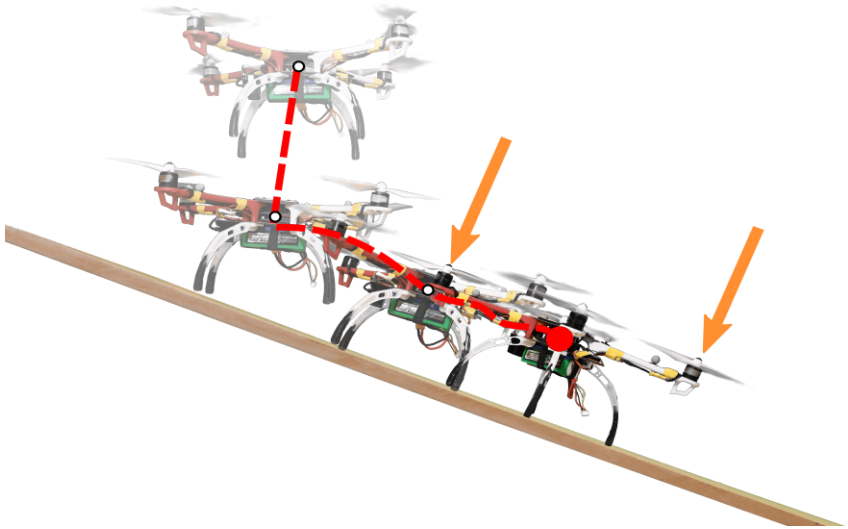
Friction shock absorbers (FSA)

- No elastic energy accumulated
- Adjustable friction
- Simple and lightweight



Reverse thrust (RVT)

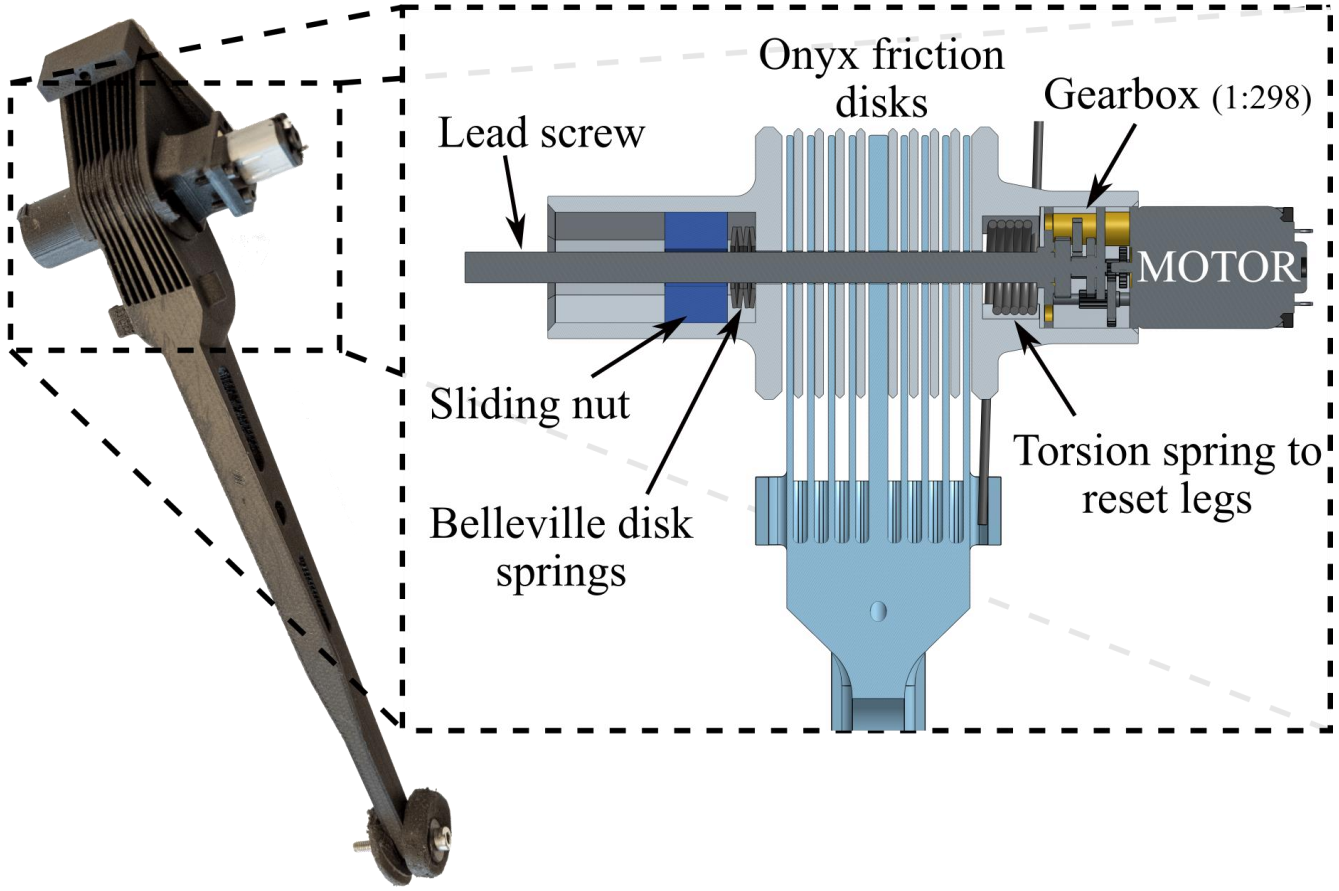
- Increased friction force on ground
- Create forces that counter flipping motion
- No added weight

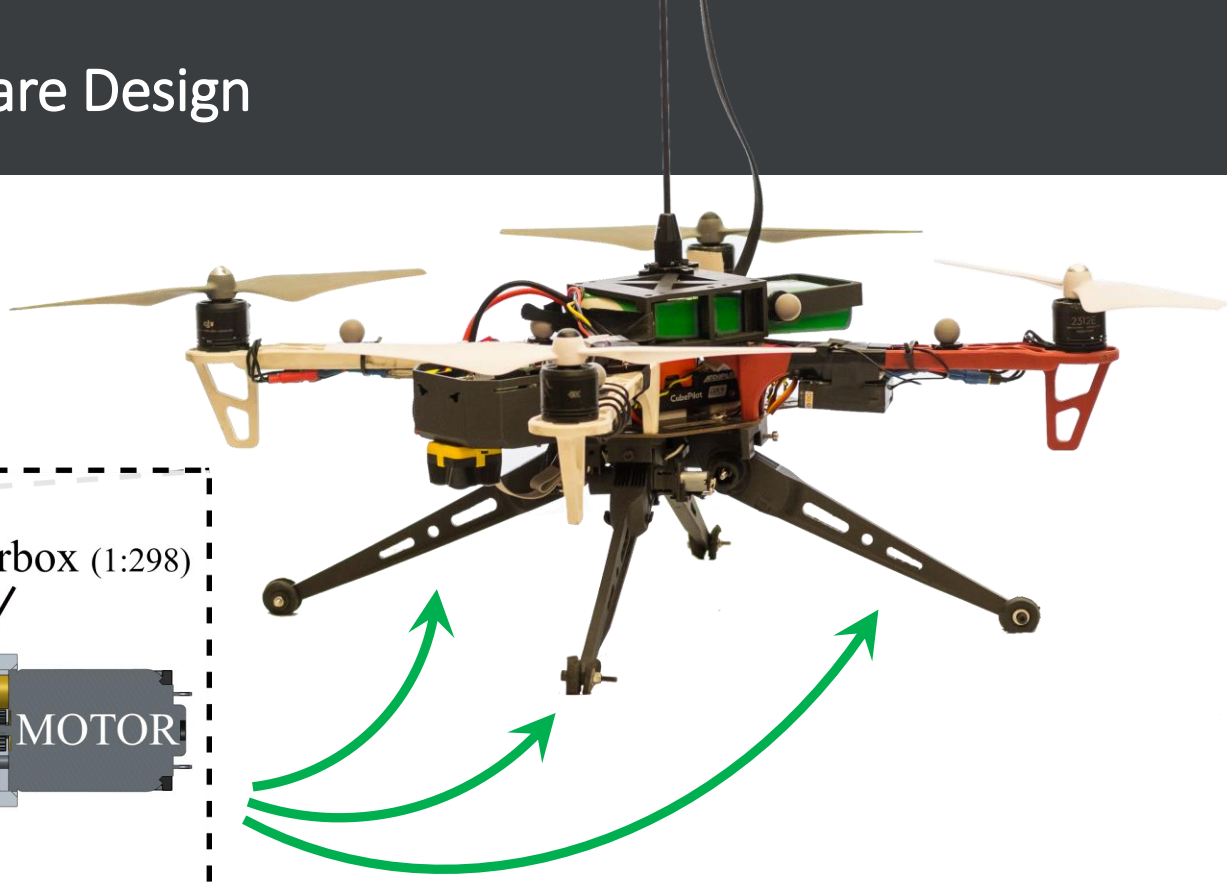


Method

Hardware Design

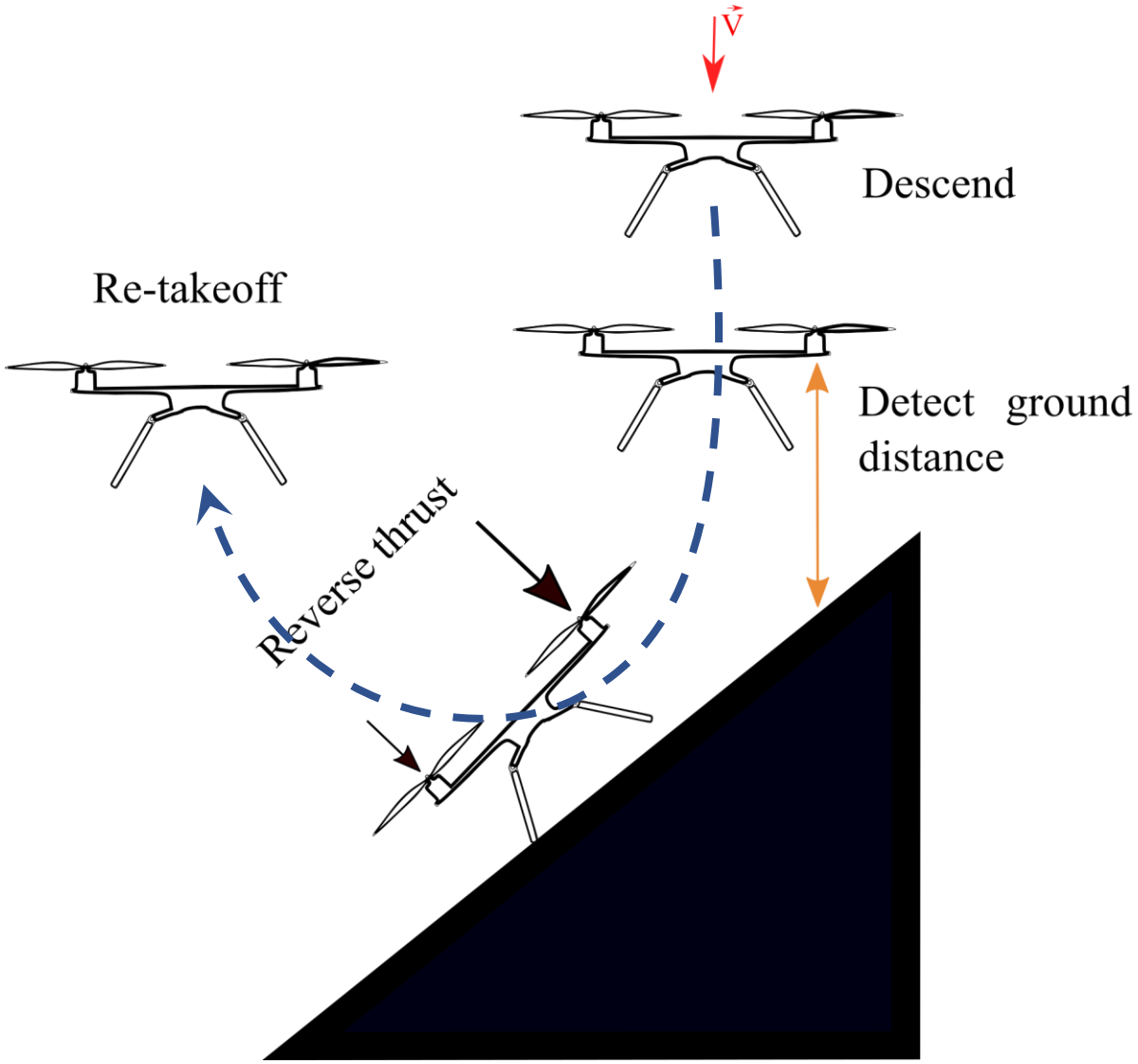
- Lightweight passive landing gear
- Adjustable friction levels
- Automatic legs reset





Method

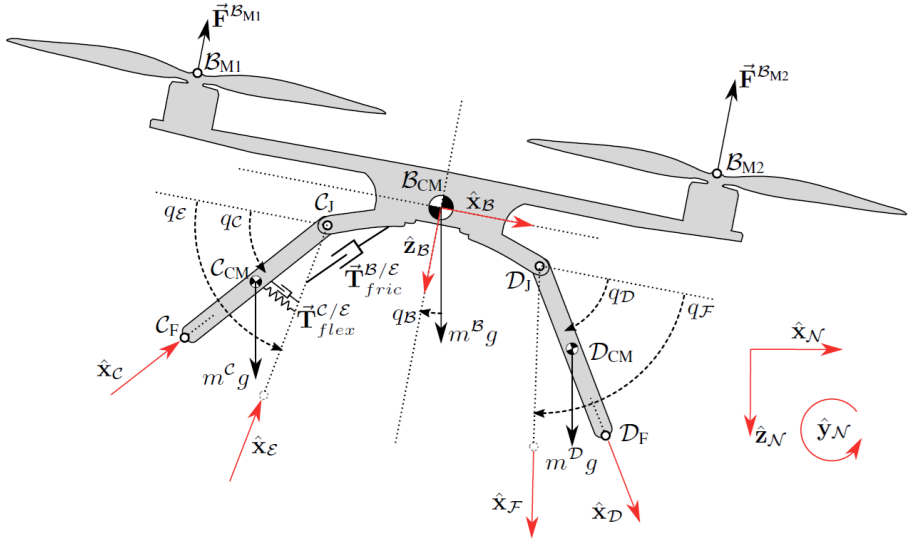
Software Design



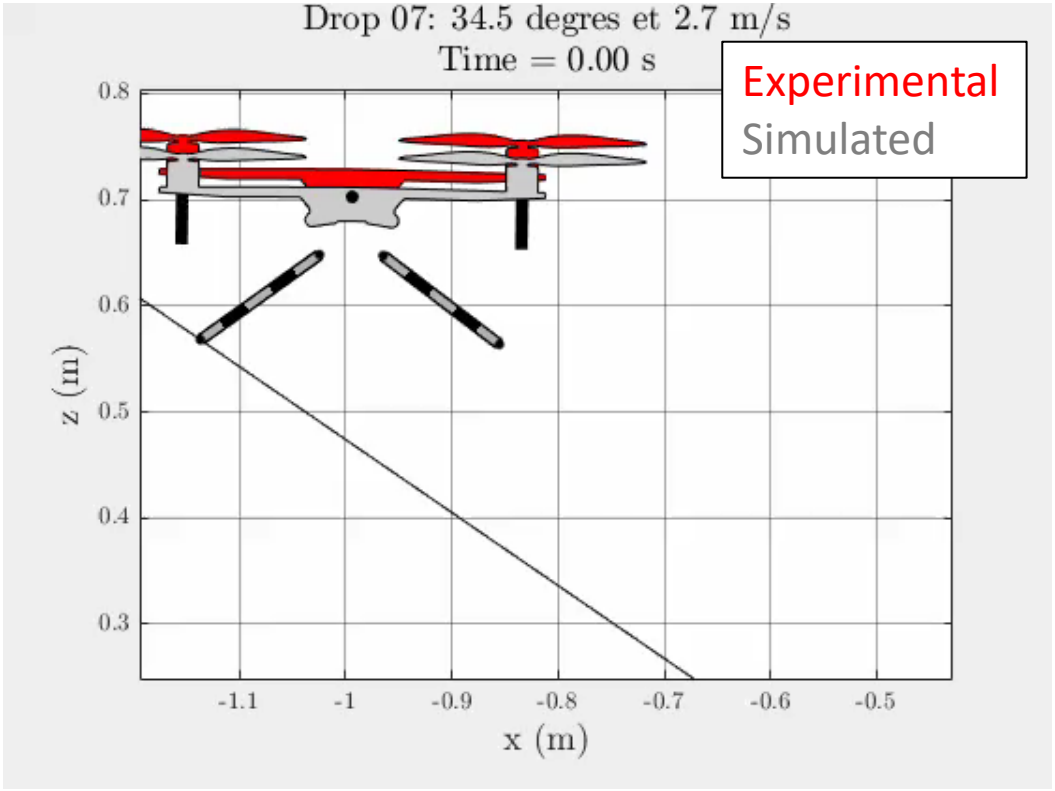
Method

Dynamic Model

- 2D dynamic model in MATLAB
  - Validated using experimental drop recorded with motion capture equipment



  - Allowed to find the best parameters for hundreds of impact conditions



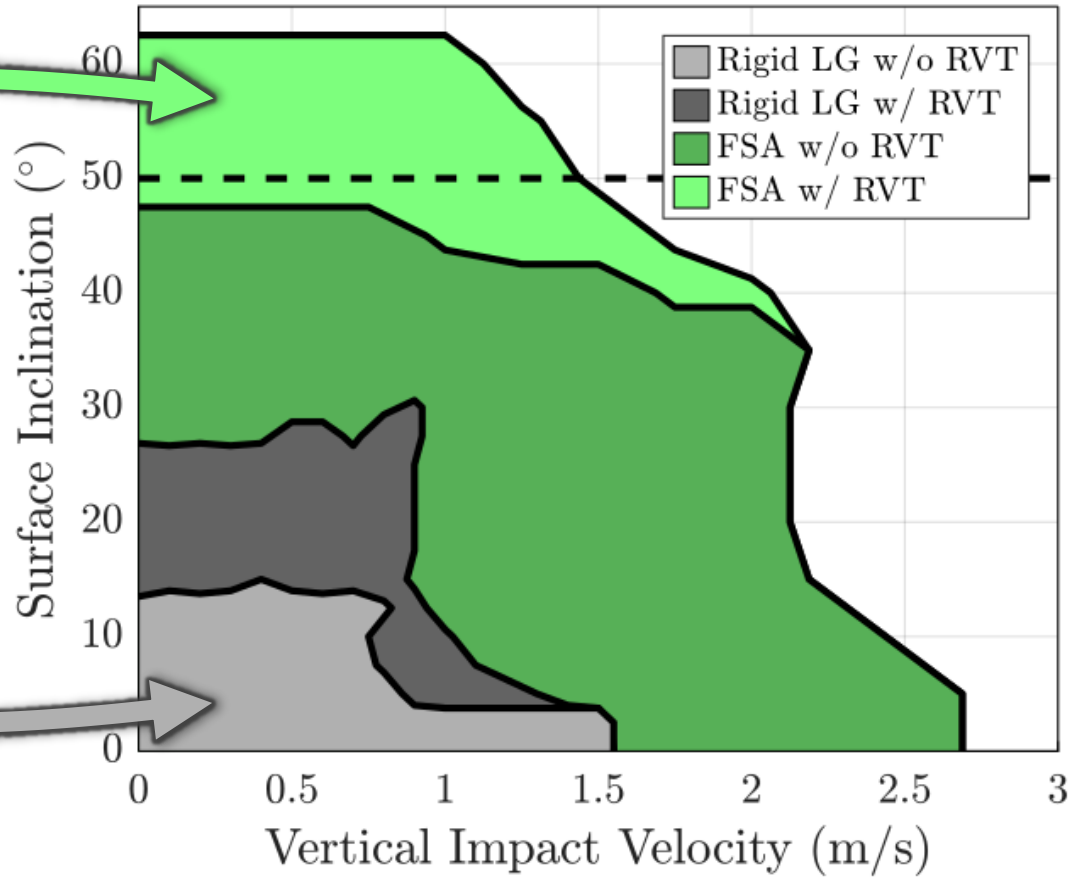
Results

Envelope Simulations

Using FSA and RVT

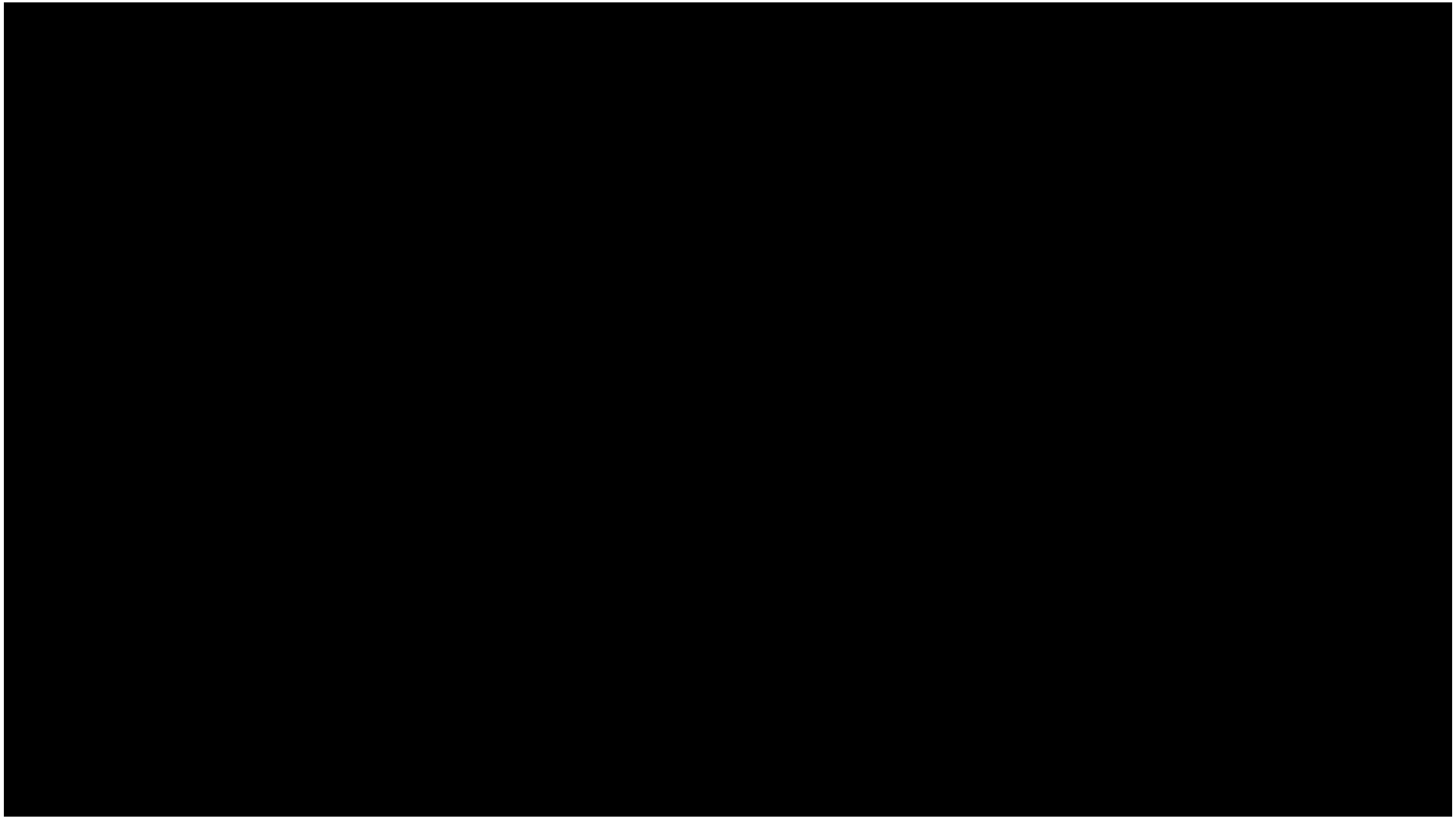
8x larger!

Regular commercial drone



Results

Experimental Trials



UNIVERSITÉ DE SHERBROOKE

3IT Institut interdisciplinaire d'innovation technologique
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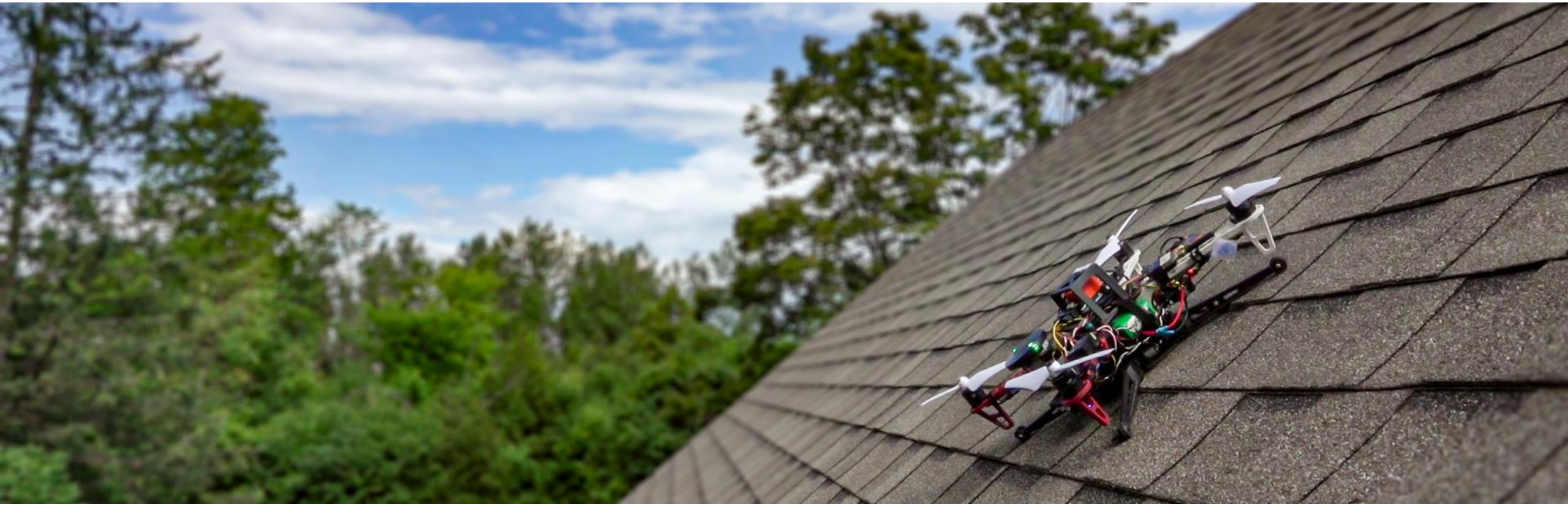
CREATEK

NCRN NSERC Canadian Robotics Network
RCRC Réseau canadien de robotique du CRSNG



THANK YOU!

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