Collision avoidance for CubeSats and SmallSats with ARM-C

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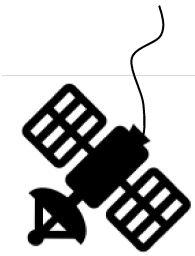
EXECUTIVE SUMMARY

WHY? - The challenge

Space debris in orbit increases the risk of collisions and blocks our view into space. Ability for collision avoidance is important and sustainable. Solving your collision risk enables you to...

+ comply with tightening **legislation** and **reduce risks** in the future
+ integrate the smallest propulsion system in the world **easily** due to its **plug and play design**
+ become **sustainable** & gain **public acceptance**

Read more: ***Use case descriptions***



WHAT? - The solution

The Aurora Resistojet Module for Collision avoidance is a microscale propulsion system, less than 0,05U, about size of a swiss-knife, utilizing a water-based propellant for ensuring the safety of your CubeSats and SmallSats

Read more: ***Product concept***

HOW? - The technology in more detail

The ARM-C generates 1 mN of thrust on command with a single resistojet thruster. The device is built for serial production, making the system affordable and available on demand. It is highly scalable; you need a single unit for upto 25 kg satellites and multiple units (2-10) installed side by side for bigger satellites upto 300 kg. It requires only a few watts of power when fired.

Read more: ***Technology in more detail***

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THE CHALLENGE – COLLISION AVOIDANCE USE CASES

There are two main use cases for the Aurora Collision Avoidance: 1) Collision avoidance for CubeSats 2) Collision avoidance for SmallSats

Collision avoidance for CubeSats

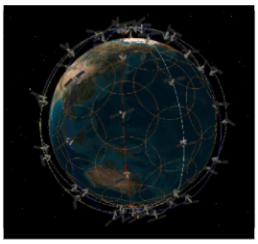
Cubesat missions & constellations

- [x] THRUSTERS
- [ ] PLASMA BRAKE

Challenges	Solution	Benefits
Are you planning a CubeSat mission for a research project, technology demonstration or are you building commercial constellation? Do you need collision avoidance at a **reasonable cost?** Is your mission highly reliant on being **accepted as sustainable** by partners, customers, investors and wider public? If so, the capability for avoiding collisions is not a luxury, it is a necessity.	Aurora's water based micro resistojet technology provides a **flight qualified basis** for our collision avoidance product (ARM-C). →less than **0,05 U**, about the size of a swiss-knife. →ability to perform **several collision avoidance maneuvers** depending on the satellite mass. →**easy to integrate** due to its plug & play design →**highly scalable**: need a single unit for upto 25 kg satellites and 2-10 units installed side by side for upto 300 kg satellites.	→Direct economical benefits come from prolonging your productive uptime in space by avoiding a collision. →Reputational benefits come from being among the first, not the last, to act on space debris mitigation. →Aurora's solution is extremely **light** and **cost efficient** way of gaining a collision avoidance capability previously seen only in bigger satellites. →Expected **savings** on annual in-flight insurance costs

Collision avoidance for SmallSats

SmallSat Missions & Constellations



- [x] THRUSTERS
- [ ] PLASMA BRAKE

Challenges	Solution	Benefits
Are you building a SmallSat for advanced research or are you building a large & complex commercial constellation? Are **quality, operational longevity & risk reduction** your top priorities? Collisions are especially hazardous in complex systems such as constellations. Though the probability for a collision is small, it is growing and the potential effects are increasing. The need for a reliable collision avoidance system is evident.	Aurora's water based micro resistojet technology provides a **flight qualified basis** for our collision avoidance product (ARM-C). →less than **0,05 U**, about the size of a swiss-knife. →ability to perform **several collision avoidance maneuvers** depending on the satellite mass. →**easy to integrate** due to its plug & play design →**highly scalable**: need a single unit for upto 25 kg satellites and 2-10 units installed side by side for upto 300 kg satellites.	→Direct economical benefits come from prolonging your productive uptime in space by avoiding a collision. →Reputational benefits come from being among the first, not the last, to act on space debris mitigation. →Aurora's solution is extremely **light** and **cost efficient** way of gaining a collision avoidance capability or getting a redundant system to increase collision avoidance reliability. →Expected **savings** on annual in-flight insurance costs

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THE SOLUTION – PRODUCT CONCEPT

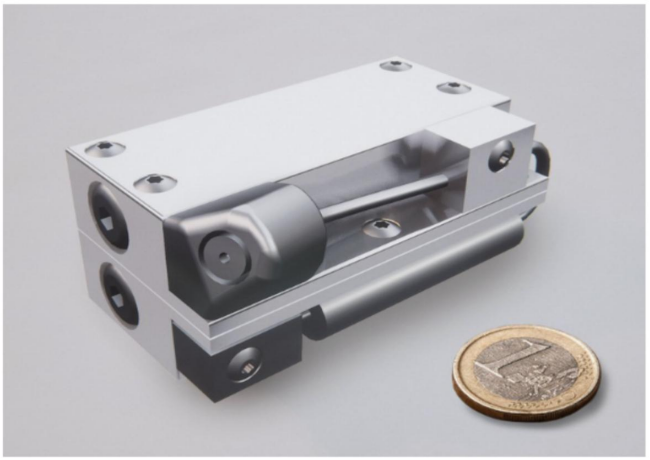
ARM-C IN A NUTSHELL

With the Aurora Resistojet Module for Collision-avoidance, you can effectively avoid collisions up to 25 kg mass per ARM-C Unit and it works on any orbit.

ARM-C is small (total volume 0.05 U), which brings many benefits:

Save your satellites space for payload and achieve more with smaller size.

Do not toss coin for collisions and save for insurance of the satellite.



Preliminary illustration of the ARM-C

Main components of the ARM-C are

1. Standard housing, easy to mount to any satellite
2. Minimalistic integrated actuation electronics
3. Aurora Resistojet Thruster

ARM-C IS SAFE AND DEPENDABLE

The ARM-C is inherently safe and reliable due to its simplicity. It is also safe for other satellites and the environment due to water based propellant.

ONE SOLUTION AND MODULAR SCALABILITY

It's the simplest variant of the product family: it generates 1 mN of thrust on command with a single resistojet thruster. The device is built for serial production, making the system affordable and available on demand. It is highly scalable; you need a single unit for upto 25 kg satellites and multiple units (2-10) installed side by side for bigger satellites upto 300 kg. It requires only a few watts of power when fired.

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TECHNOLOGY IN MORE DETAIL

The Aurora Resistojet Module for Collision avoidance is a microscale propulsion system utilizing a water-based propellant for ensuring the safety of your CubeSats and SmallSats.

Resistojet is like a turbocharged cold gas thruster, which is the most simple and traditional propulsion. In the resistojet the propellant is heated with a resistor coil up to hundreds of °Cs, which creates pressure and therefore increases the impulse up to 2 times compared to a cold gas thruster. It keeps the added components as simple as possible, and increases reliability of the system.

SPECS

Quantity	Value
Form	~ 3 * 3 * 5 cm^3
Target satellite	Single unit for up to ~25 kg satellite. 2-10 units for up to ~250 kg satellite.
Power	5 W avg during burn, 12 W peak
Thrust	1 mN
Control	Simply pull two pins (preheat, burn) HIGH to activate a burn.
Total impulse	Enough for 3-20 avoidance maneuvers.
Wet mass	~ 50 g
Dry mass	~ 45 g
Lead time	1-2 months from order.
Availability	First delivery January 2023
Customizability	A custom mounting plate can be produced.