MAARCO – **M**ulti-Terrain **A**mphibious **ARC**tic expl**O**rer

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Motivation

Existing Rover Technology

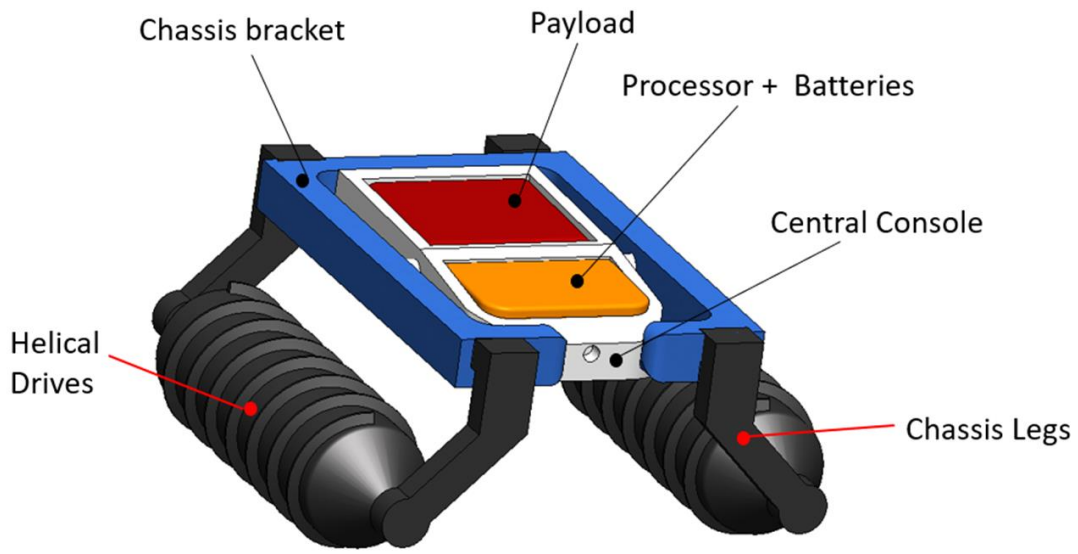
- Autonomous rovers have been used for exploring remote and inaccessible regions
- For example, the *Nomad* rover was used for surveying and data collection in Antarctica
- Technological Gap 1: **Rovers are limited to flat and mostly uniform terrain**
- Technological Gap 2: **Rovers do not have amphibious locomotion capabilities**

Exploring The Arctic

- The rapidly changing Arctic climate presents unique and heterogeneous combinations of terrains
- Snow, melting ice, partially-frozen lakes, wet/firm permafrost, sea ice, open ocean
- Rovers need to have multi-terrain and amphibious locomotion capabilities

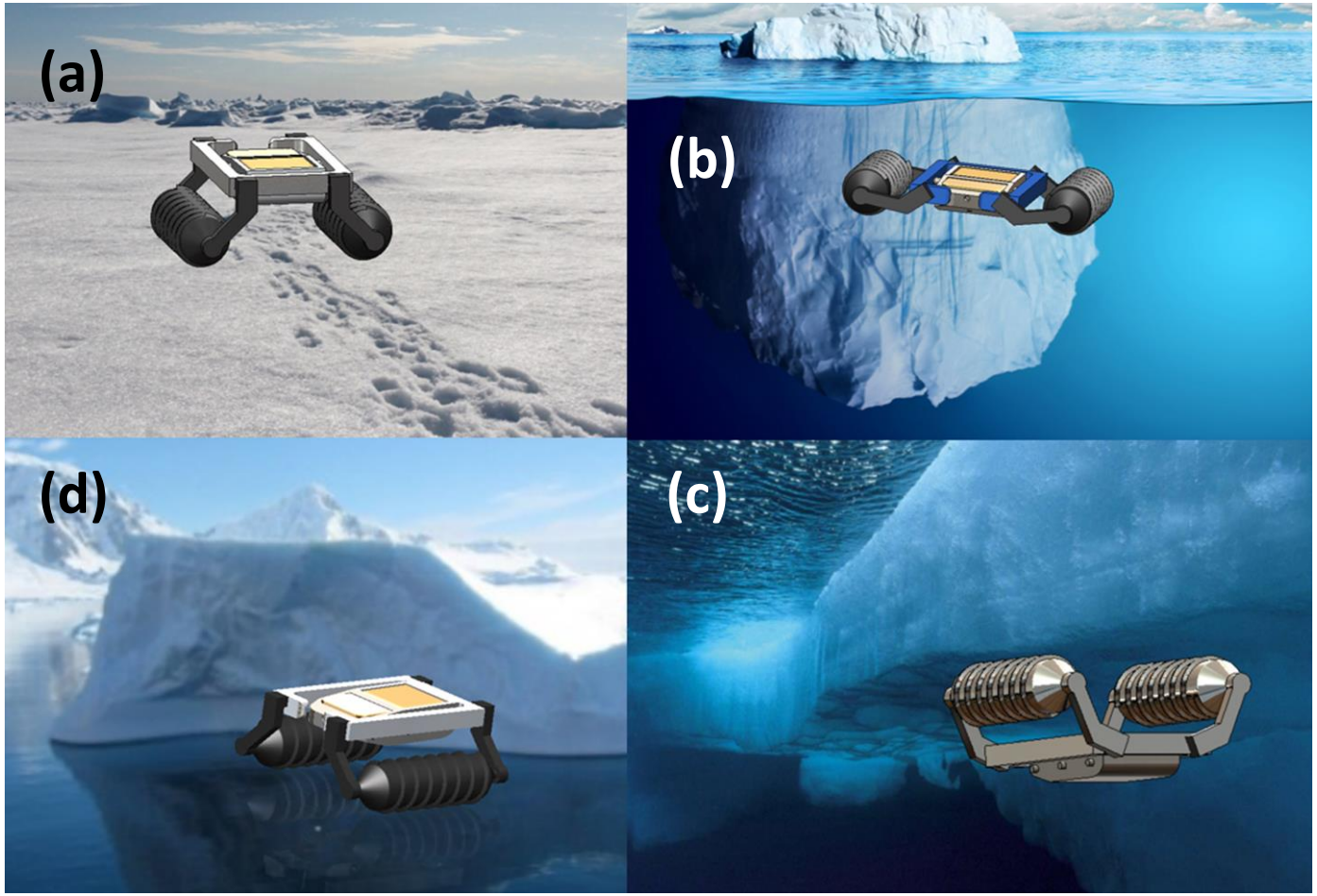
Proposed Rover Concept

- The central console carries the payload, control and communication electronics, and energy storage components
- The helical drives can be empty, partially– or fully-flooded
- The small number of moving components and the simple design makes the rover easy to build and requires limited maintenance compared to more complicated systems like tracks—perfect for long range autonomous missions



Rover Configurations

(a) Roving (b) Swimming (c) Under-ice crawling (d) Boating



Lab-Scale Experimental Setup

- An experimental rig is being developed to validate the terrestrial locomotion dynamic model of the helical drives
- A singular helical drive is guided to move along the x-direction using a friction-less rail
- The constraining forces acting along the y– and z– direction are measured using a six-degree load cell
- The location and rotational speed of the helical drive is measured using encoders on board the experimental setup
- Performance of various helical drive designs in different substrates mimicking the ground conditions in the Arctic will be estimated using the experimental setup

Work-In-Progress & Future Work

- 1:5 scale prototype design and fabrication
- Validation of terrestrial locomotion dynamics using lab-scale experiments
- Validation of underwater propulsion dynamics using water tunnel setup
- Development of an optimization framework to derive design, control strategy, and energy budgeting as a function of Artic mission requirements
- Formulation of Arctic survey missions
- Design and Fabrication of a full-scale rover
- Validation of full-scale rover in field conditions