CRANSEDS SPONSORSHIP PROSPECTUS 2020

About Cranfield

- Cranfield University grew out of the college of Aeronautics, established originally in 1946.
- Focuses in postgraduate degrees in the fields of engineering, manufacturing and management.
- Ranked number 36 in QS World University Ranking in the fields of mechanical, aeronautics and manufacturing engineering, being the fourth UK university after Oxford, Cambridge and Imperial College London.
- This year received the sixth Queen's Anniversary Prize, which is the highest award in the UK for higher educational institutions.

ABOUT US

We are a local UKSEDS branch (UK Students for the Exploration and Development of Space).

Having a strong heritage of competing in student rocket and rover competitions.

Aiming high for 2020, CranSEDS is currently competing in six competitions.

One of the few UK universities competing in the European Rover Challenge 2020, a competition sponsored by the Mars Society, the European Space Foundation and the European Space Agency.

European Rover Challenge

- Europe's largest rover competition held in a simulated Mars environment in Kielce, Poland.
- 20 dedicated members are challenging themselves to design, build and test the necessary sub-systems to compete in the challenge.
- Objective: developing a rover with autonomous abilities which can be operated from 100 to 200 meters from a ground station using cameras, motors and sensors, able to overcome the different tasks described in the ERC rules.

Tasks to face in the ERC

SCIENCE TASK

MAINTENANCE TASK

COLLECTION TASK

TRAVERSE TASK

PRESENTATION TASK

Rover Requirements


SCIENCE TASK


MAINTENANCE TASK


COLLECTION TASK


TRAVERSE TASK


PRESENTATION TASK

- Rover should be a standalone, mobile platform.
- Weight should be less than 50Kg during any task.
- Maximum speed of rover should not be grater than 0.5 m/s.
- Communication abilities between rover and ground station, which are 100m away.
- Communication has to be done with the accepted frequencies of competition.
- Automation capabilities i.e. different operating states like idle, working, wait, abort, resume, emergency stop.
- Team proposal, preliminary report, final report, video material, field trails are different stages of the competition, being the team proposal submitted before 26th of March and the field competition the 10-13th of September.

Rover Features – Initial Design

ROBOTIC ARM

ROVER DRIVE SYSTEM

SUSPENSION MECHANISM

UNIQUE WHEEL DESIGN

VISION SYSTEM

ON BOARD SCIENCE SETUP

AUTONOMOUS ABILITIES

STORAGE

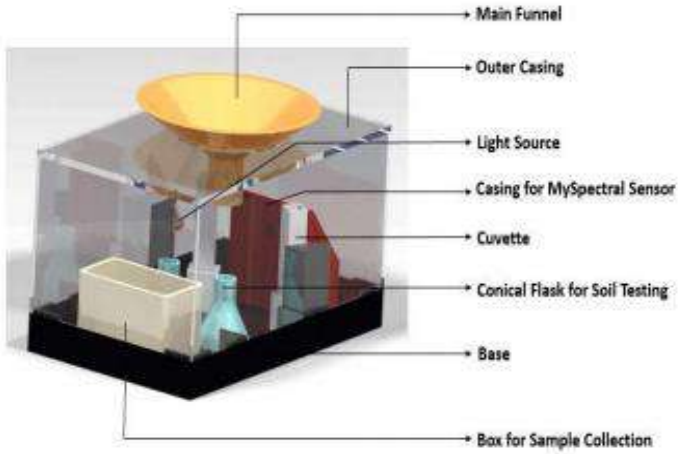
Initial Rover Design developed using SolidWorks. Iterations needed made by optimizing various parameters to get better results for different tasks of the competition.

Science Task

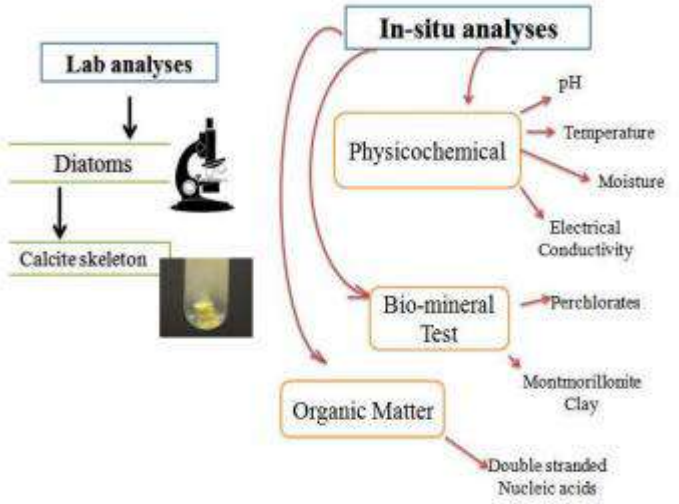
SCIENCE TASK | MAINTENANCE TASK | COLLECTION TASK | TRAVERSE TASK | PRESENTATION TASK

- **Aim**: Obtain samples form surface and subsurface layers of the soil each taken from different locations using robotic arm with end effector that could able perform drilling and caching.

1) drilling - different levels of soil cohesion and hardness (soil or rock)
    1) separation of reaction forces from rover body
    2) robustness and repeatability
    3) task automation
    4) performance (energy, scalability, operation time)
2) caching
    1) delivery - the quality of operation transporting the sample from sampling place to container
    2) accuracy of placement - putting samples accurately into the container and in a controlled way
    3) quality of container sealing design
    4) accuracy of container design regarding real missions requirements.
3) in-situ sample analysis/processing
    1) effectiveness and quality of self-made solutions for sample analysis/processing
    2) accuracy of proposed solutions regarding real missions requirements.
4) surface sampling - unknown soil density
    1) separation of reaction forces from the rover body
    2) robustness and repeatability
    3) task automation
    4) performance (energy, scalability, operation time)



In-suit setup Design and working procedure

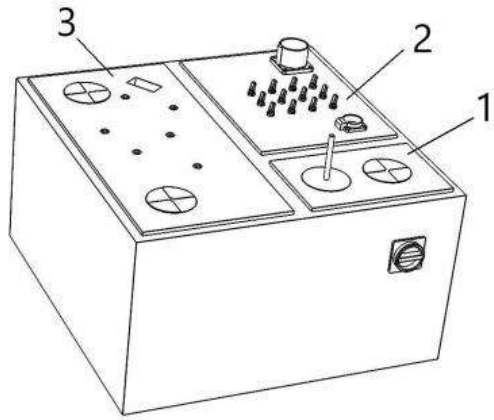


Maintenance Task

SCIENCE TASK | MAINTENANCE TASK | COLLECTION TASK | TRAVERSE TASK | PRESENTATION TASK

- **Aim**: The team has to use the rover manipulating device to set switches to the required positions, measure electrical parameters, set other panel controls and observe indicators' feedback.

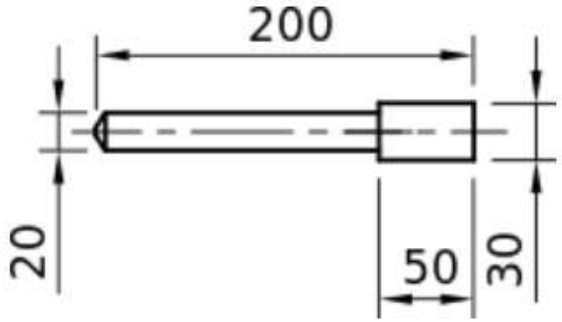
1) task automation
   a) automatic elements detection (e.g. spatial parameters, possible actions etc.)
   b) automatic approach
   c) automatic manipulation
2) teleoperator interface
   a) dynamic operator feedback (e.g. presentation of feedback measures, force-feedback/control interfaces, etc.)
   b) operator situational awareness (e.g. vision, parameters presentation and displays ergonomics, etc.)
   c) ergonomics of the operator control interface
3) end-effector performance
   a) tool relevance for a specific scenario
   b) multiple tool systems (interfaces, exchange) or universal tool design
   c) operation robustness (flexibility etc.)
   d) operation accuracy and quality for a specific scenario
4) manipulator performance
   a) operation robustness
   b) operation accuracy and quality for a specific scenario



Initial panel design

End effector design

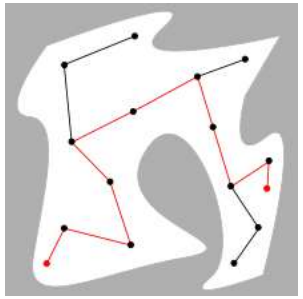
Collection Task



SCIENCE TASK | MAINTENANCE TASK | COLLECTION TASK | TRAVERSE TASK | PRESENTATION TASK

- **Aim**: The team has marked locations on a map and has to reach them, locate and pick up a small object (maximum weight 300g) on each location.

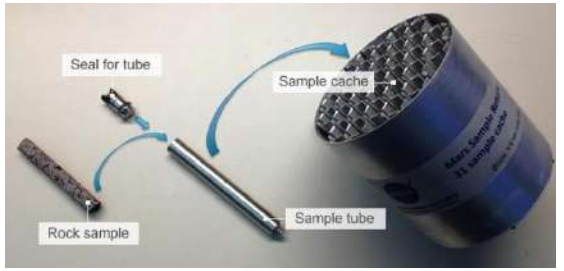
Automated movement: path planning and following using LiDar, odometry and complementary sensors (laser, camera and/or ultrasonic)



Object approach: detection of the piece (could be partially buried or covered with soil) using a camera in the robotic arm and object detection (AI + Machine Vision)

Object pickup: end effector attached to the arm needs to reach the position and grasp the piece with different orientations

Insertion to container: detachable containers for at least 4 objects designed to optimally store the pieces easily without damaging them.



Traverse Task

- **Aim**: demonstrate the system ability to semi or fully autonomous traverse without using any GNSS system.

- Rover needs to be autonomous, traversing and gathering important data on its way.
- Rover needs to reach 4 basing waypoints, also additional waypoints in challenging terrain.
- Rover should able to plan an optimal path based on given way point coordinates.
- Present the systems and methods used for autonomous traverse and gathered data in a Guided User Interface (e.g. a map showing the planned path, actual position, reached waypoints, position errors, etc.).

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We need your Support…

- Currently in rover design phase.
- Building a very simple prototype with scrap materials and 300£ budget.
- Would appreciate advice / comments related to the design of the body.
- Discount, or financial help in the fabrication of the body.
- Components, fabrication and/or coupling of the suspension system.

Commercialization Aspects

IN SUIT SETUP FOR SOIL PARAMETERS

ROBOTIC ARM DESIGN

MAINTENANCE IN INDUSTRIES

DISASTER MANAGEMENT

AUTONOMOUS PATH PLANNING

DRIVERLESS CARS AND PODS

DELIVER PRODCUTS

Commercialization Aspects

- In suit setup can help us in Analysis of presence of life and study about the soil parameters .
- Traversing abilities of rover make sure that surveillance , reaching difficult parts where human could not reach
- Robotic Arm Design that could potentially perform various complex operation could help in industry maintenance and disaster management
- Autonomous path planning abilities lead to development of the driverless cars and pods which would be the future of transport.
- Collection task abilities makes it best robot that could deliver products to the desired locations can be used in any harsh environment

Sponsorship & What We Offer

The CranSEDS European Rover Challenge team has attracted interest from both industry and the University, however, we require additional support to help fund the rest of the projects.

What we can offer?

Sponsors could be entitled to:

- Logo placement on hardware, team apparel and website.
- Embedded marketing campaign via social media channels.
- Publicity in Cranfield University events.

Other Sponsorship Benefits

Brand Presence

- Exhibition of innovative prototypes to the stakeholders of industry
- Targeted promotion to an extensive base of young engineers, academics and members of industry & newspaper articles.

Association with Cranfield University

- Cranfield University has a long and proud history in the field of aerospace engineering in the UK
- Making Cranfield the UK's top destination for aerospace engineering and the largest provider of accredited postgraduate awards

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