

Robotic Roadworks and Excavation System

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LCNI 2018



SGN

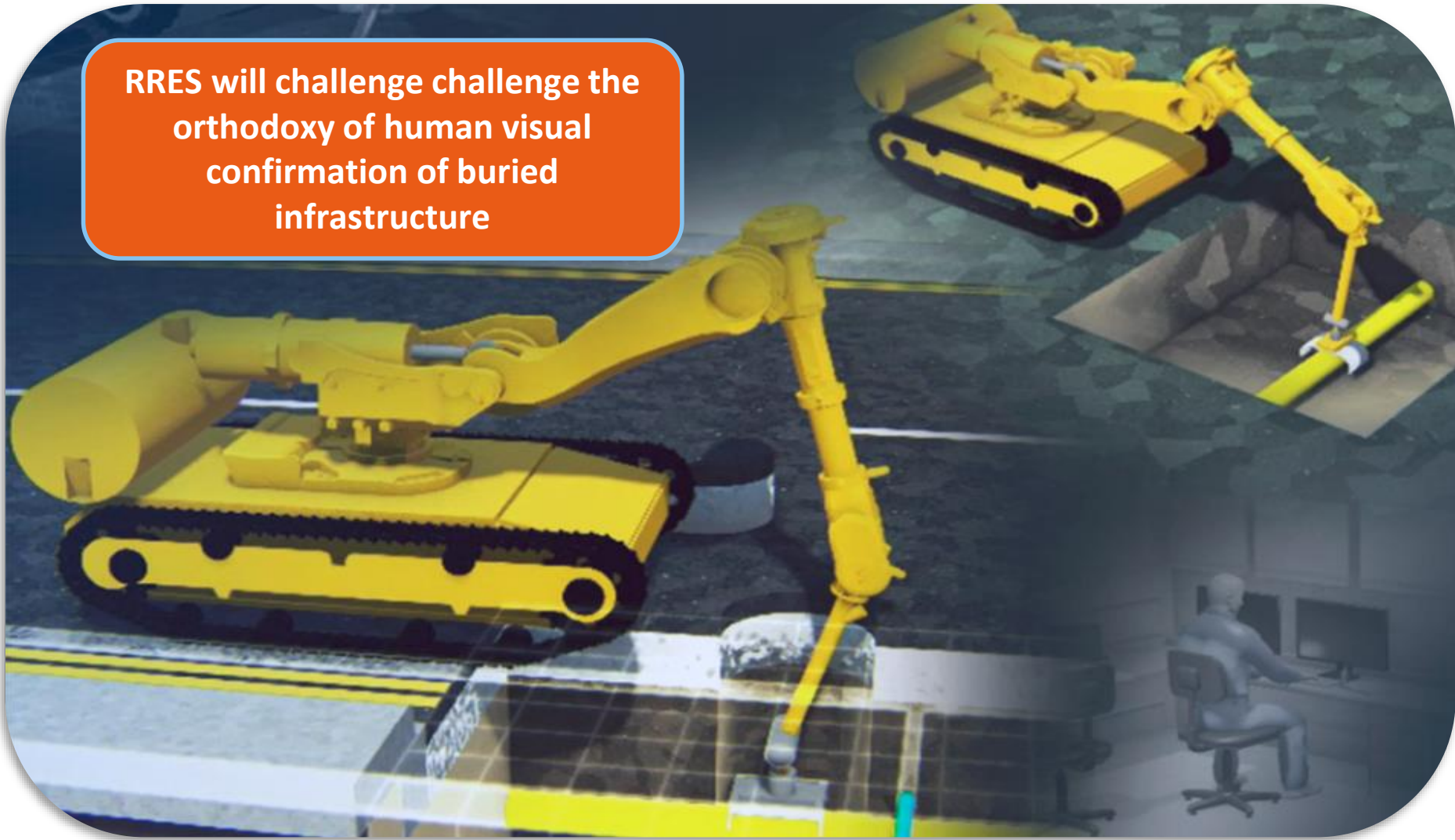
Your gas. Our network.

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RRES will challenge the orthodoxy of human visual confirmation of buried infrastructure

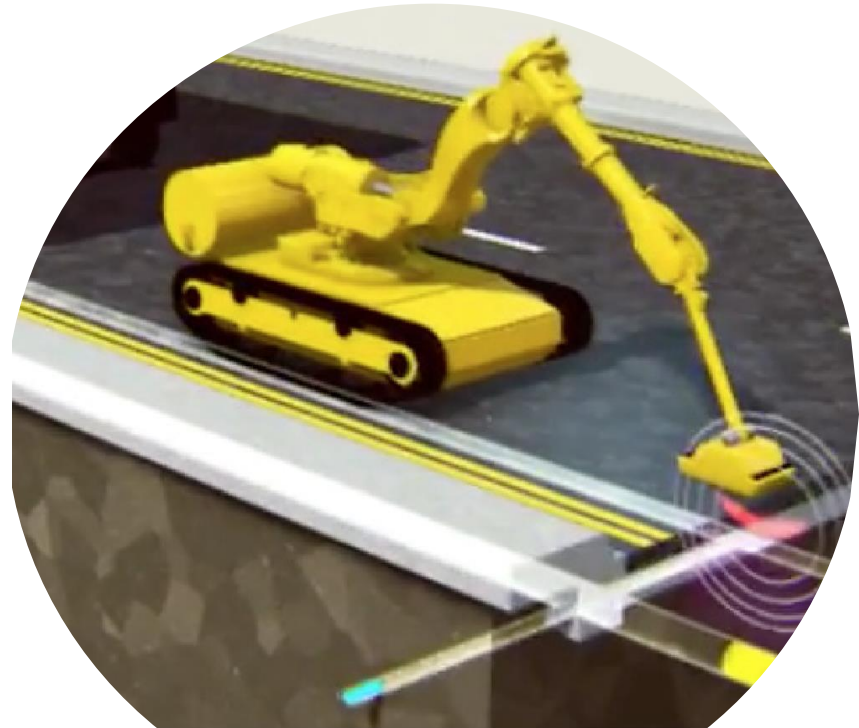




What is RRES?

Robotic Roadworks and Excavation System aims to reduce the required excavation size, labour costs, and equipment while making the work safer

The project will automate the excavation process in both transmission and distribution areas



Robotic Roadworks and Excavation System

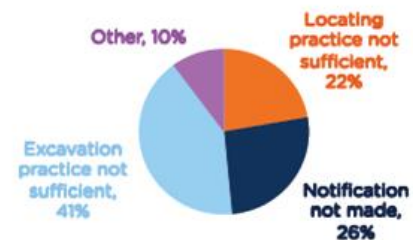
Problem

- High Cost and Labour Intensive
- Public and Environmental Disruption
- Risk of Damage to Unknown Infrastructure
- Operators' Safety



Why now?

All utilities face an ongoing challenge in safely managing excavation activities. This will continue for the life of the assets as they are pushed to return maximum value for the GB customer.





Robotic Roadworks and Excavation System

Method

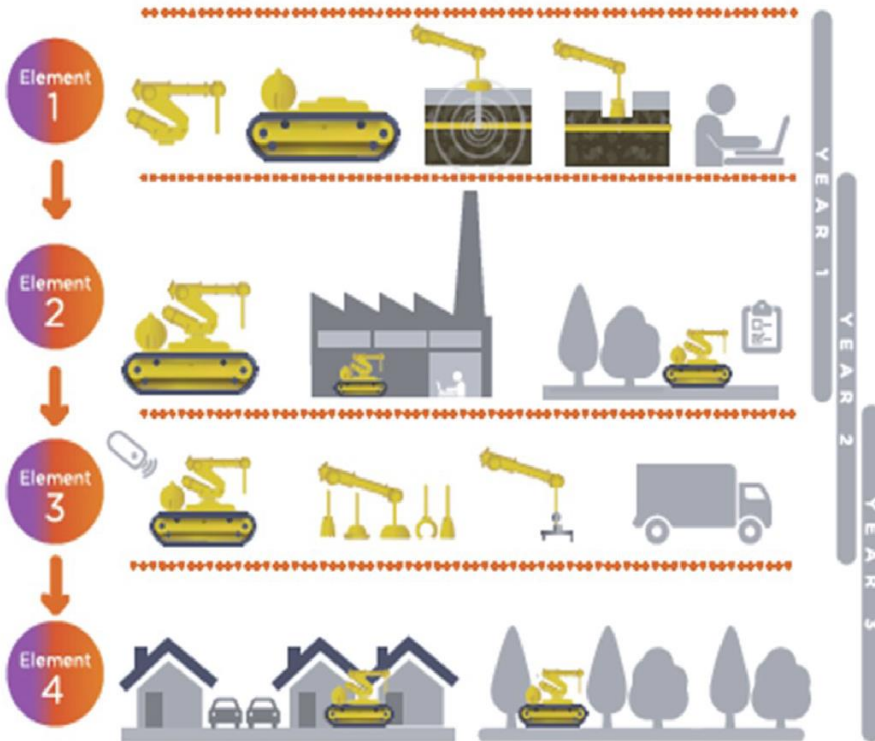
The system will fuse advanced robotic arm technology with a mobile platform, and will be controlled by Artificial Intelligence using a suite of sensors and feedback controls to enable autonomous, safe and efficient mains excavation.





Robotic Roadworks and Excavation System

Structure



Development of robotic arm, mobile platform, below-ground sensing, excavation tooling, AI and computing system

Interim integration, shop testing and field testing

Development of mobile operations, automated tool changing system, UAF and associated tooling, support equipment and support vehicle

Final integration, shop testing and field testing

RRES Benefits



RRES enables energy networks to be more efficient, more customer focused and less disruptive:

- Safe process for our people.
- Reduction in carbon emissions
- Minimal streetworks impact.
- Mobile and flexible.
- Reduced accidental damages
- Reduced noise

Benefits are cross transferable to a number of utility, infrastructure and construction sectors.



Robotic Roadworks and Excavation System

Operational Procedure

Excavation



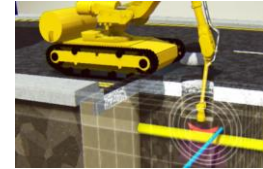
Underground Sensing



Core Drilling



Core Removing



Vacuum Excavation

Operation



Universal Access Fitting

Future Development of Autonomous Operation on the Exposed Pipes

Reinstatement



Backfilling Soil



Tamping Soil

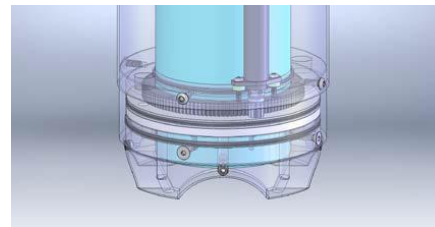
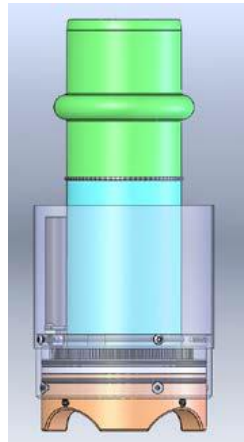
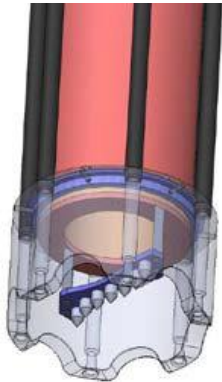


Core Reinstating

Robotic Roadworks and Excavation System

Soft Touch Excavation

- Breaking the soil and excavation in one operation
- Avoiding any potential damage to the buried utilities
- Enabling the application of core and vac excavation to previously prohibited sites
- Reducing the time it takes to carry out the operation

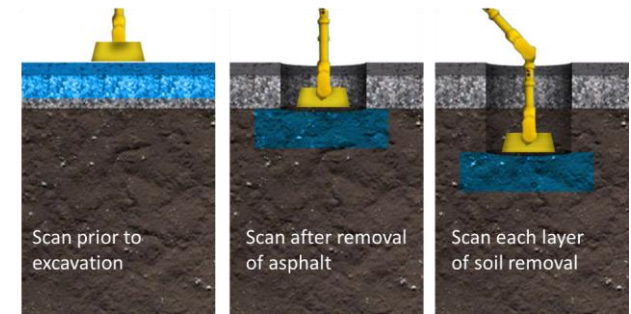
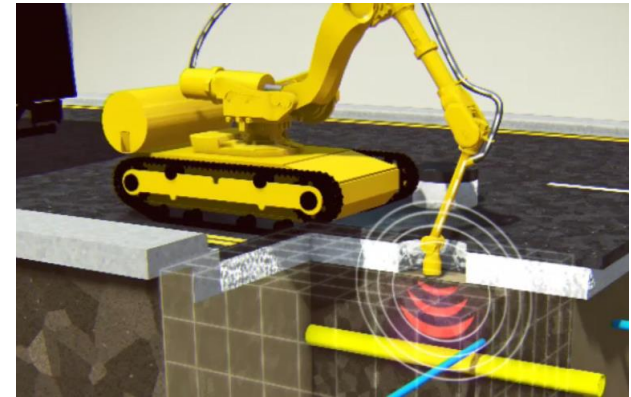




Robotic Roadworks and Excavation System

Above and Below Ground Sensing

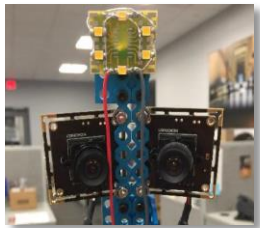
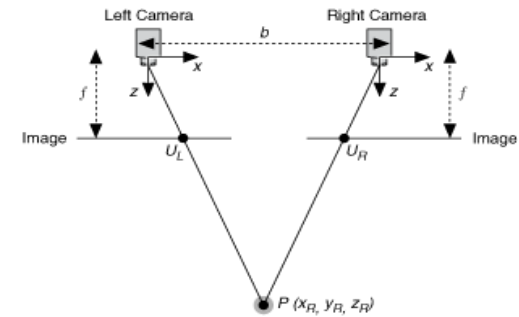
- Pre-excavation surface scanning
 - RRES will scan the surface of the marked out location to detect underground pipelines, cables and obstacles in the first layer prior to breaking ground
- Layer-by-layer scanning during excavation
 - Sensors used after each layer of soil is removed
 - RRES system will alert operator if an unknown object is identified
- Machine vision recognizes assets and avoids contact
 - Machine vision cameras and sensors will allow the system to recognize pipelines, cables and objects as layers of soil are removed
 - Support the installation of the Universal Access Fitting (UAF)



Below Ground Sensing

Stereo Vision

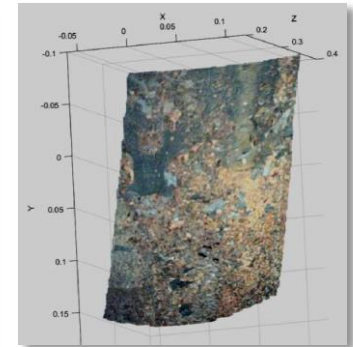
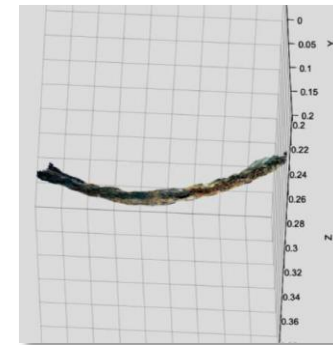
- Images are captured from two synchronized cameras
- Using pattern matching the overlapping section in left and right images are detected
- By fusion of the data from left and right images, depth information can be extracted from each data point
- Using image processing techniques, depth information can be extracted from the target



Left



Right



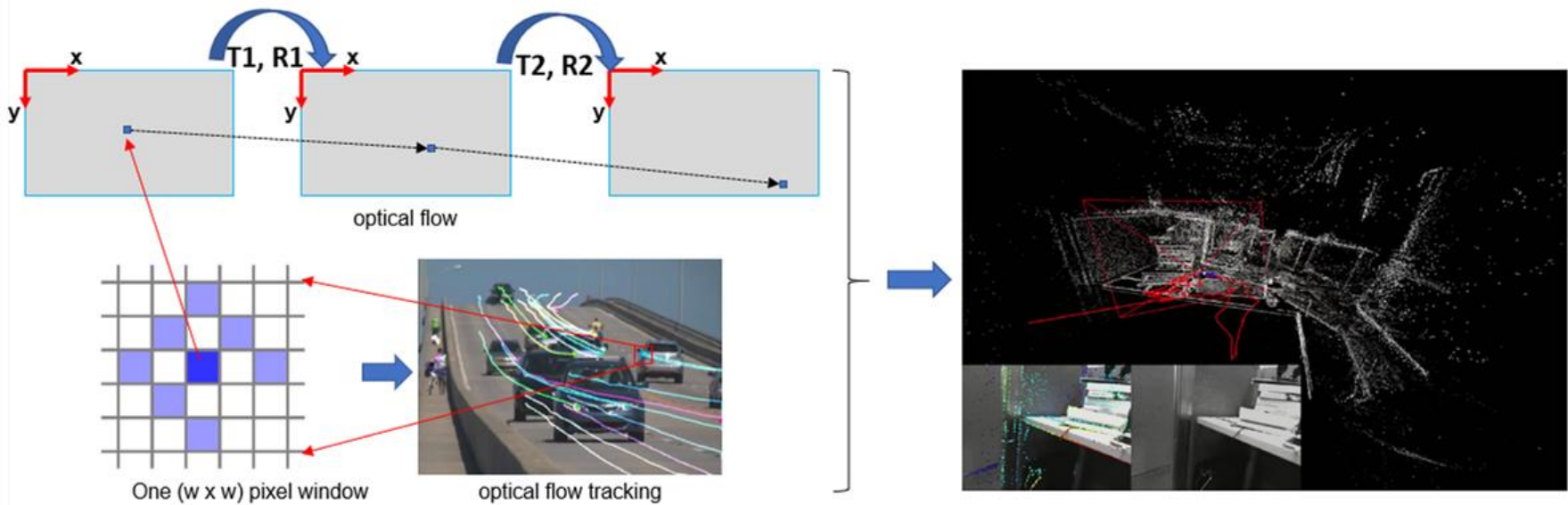
Below Ground Sensing

Stereo Vision

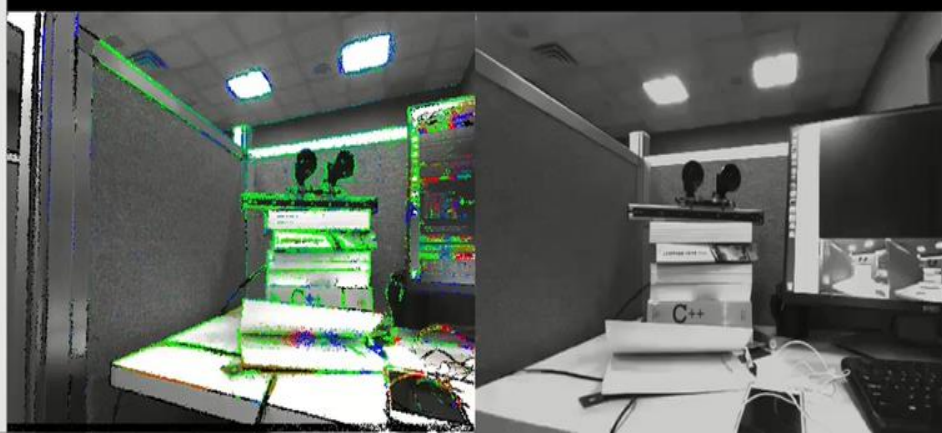


Above Ground Sensing

Simultaneous Localisation and Mapping



- PC_mode 1
- KFCam
- CurrCam
- Trajectory
- FullTrajectory
- ActiveConst
- AllConst
- show3D
- showDepth
- showVideo
- showResidual
- showFramesWindow
- showFullTracking
- showCoarseTracking
- sparsity 1
- relVarTH 0.001
- absVarTH 0.001
- minRelativeBS 0.1
- Reset
- activePoints 1200
- pointCandidates 1000
- maxFrames 7
- kifrequency 1.3
- minGradAdd 7
- Track fps -nan
- KF fps 3.254e-09



Thank you

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