Nytt fra Universitet: Droner og roboter i vedlikehold av veier
(Drones and robots in road maintenance)

by

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Oslo, January 23- 2020.

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Europe

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REQUIREMENTS FROM A PAVEMENT

Cheap (reducing initial and life cycle cost)

Safe (Skidding resistance, geometry)

Low roughness (for a smooth ride)

Low maintenance (To minimise traffic disruption)

Roads, damage and maintenance

- Cracking
- Time dependent degradation
- Ingress agressive substances

Performance

Time

Roads, damage and maintenance

Performance

- Cracking
- Time dependent degradation
- Ingress agressive substances

Time

CURRENT LIMITATIONS OF MAINTENANCE

Disruptive/slow/expensive inspections

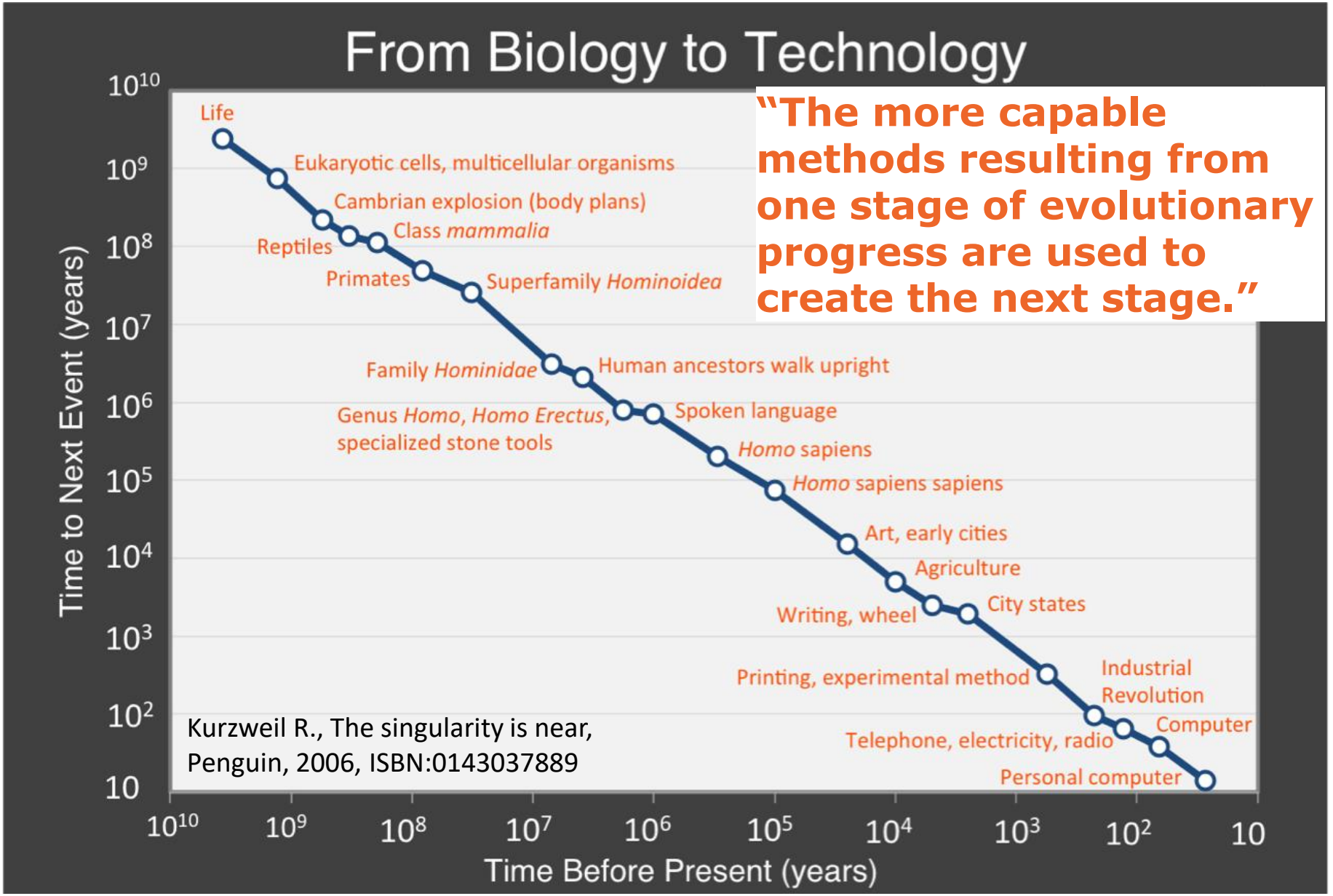
Reactive maintenance

Sometimes poor quality repairs
(not in Norway! ;-))

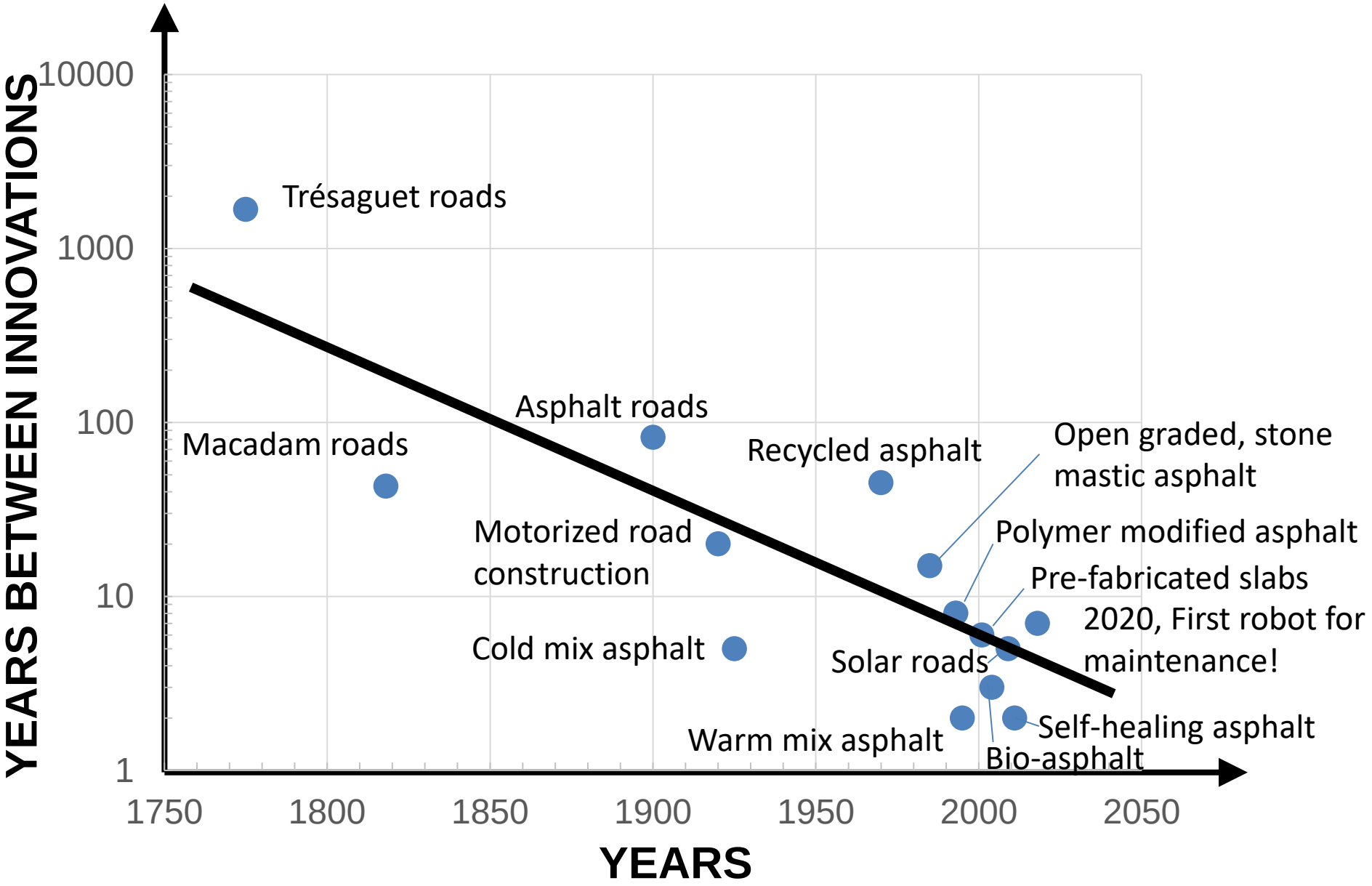
Unsafe for workers

Disruptive for users

Technology is an evolutionary process



TIME BETWEEN INNOVATIONS IN PAVEMENTS



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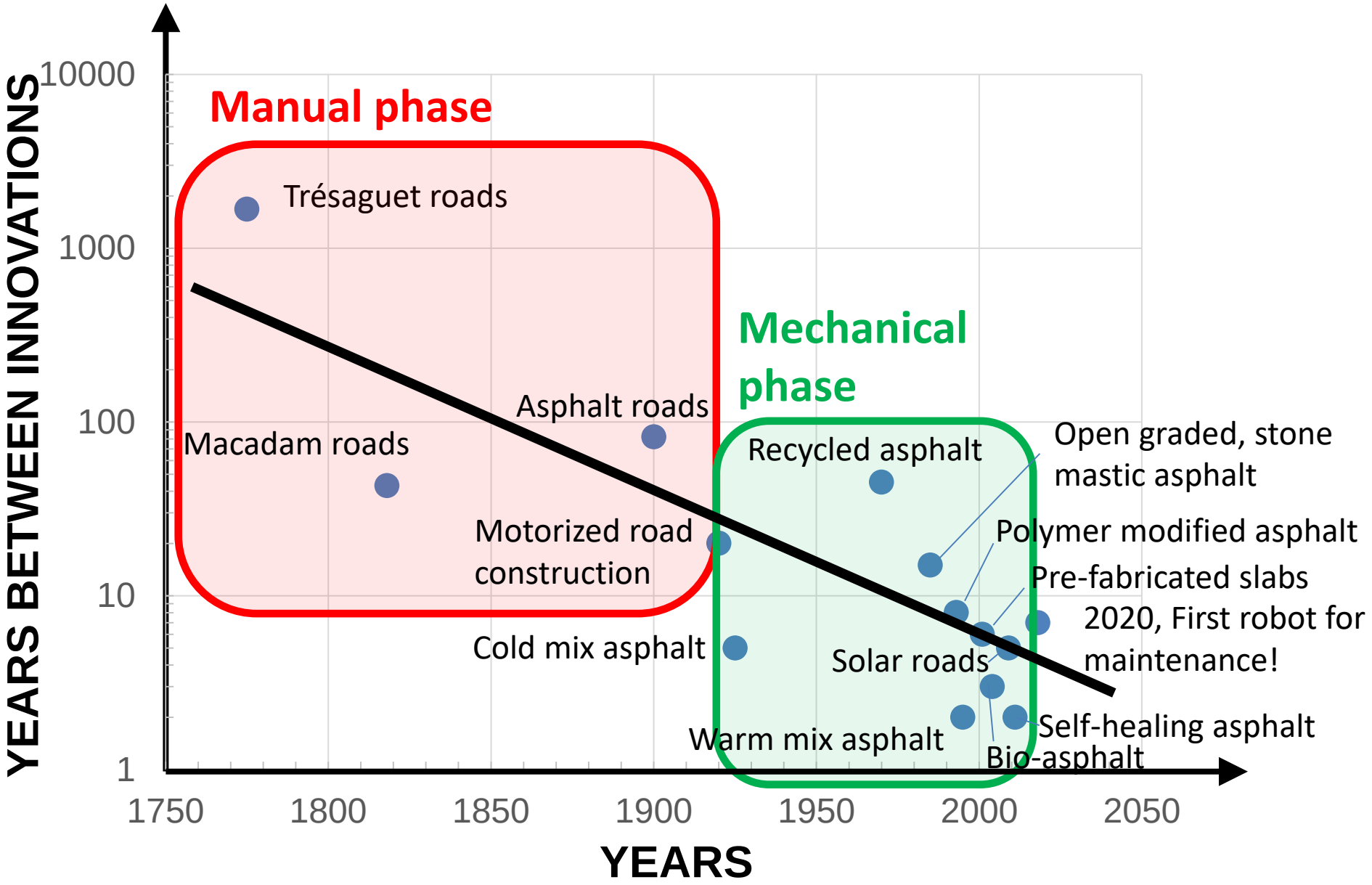
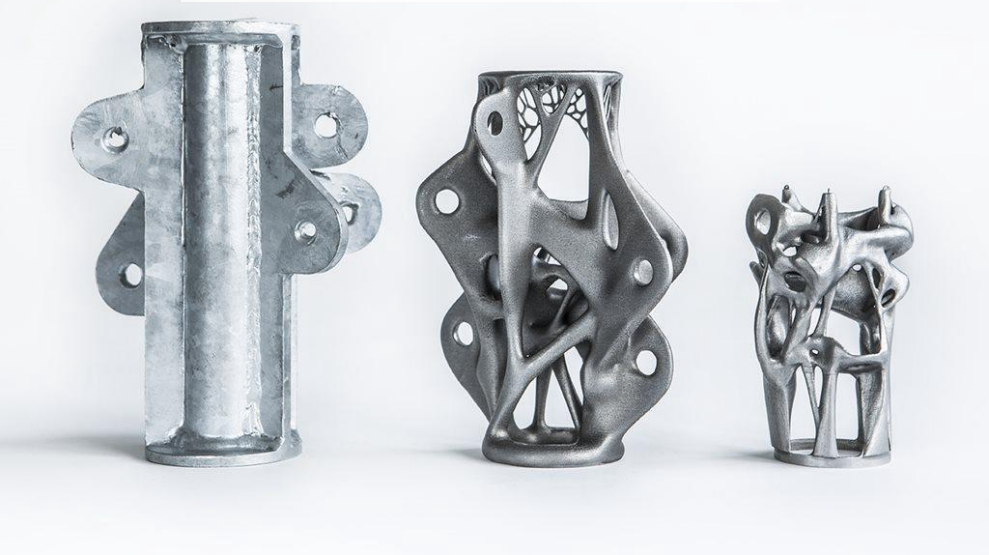
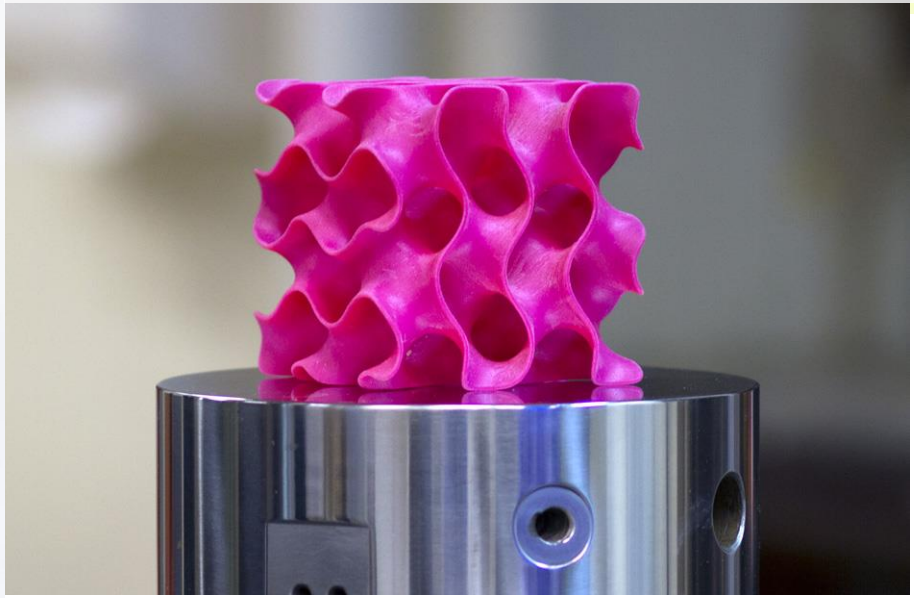


HAVE A LOOK AT THE LAST HOT INNOVATIONS FROM OTHER ENGINEERING FIELDS…

New ways to design

New machines/New materials





NEW DESIGN PROCESS IN ENGINEERING

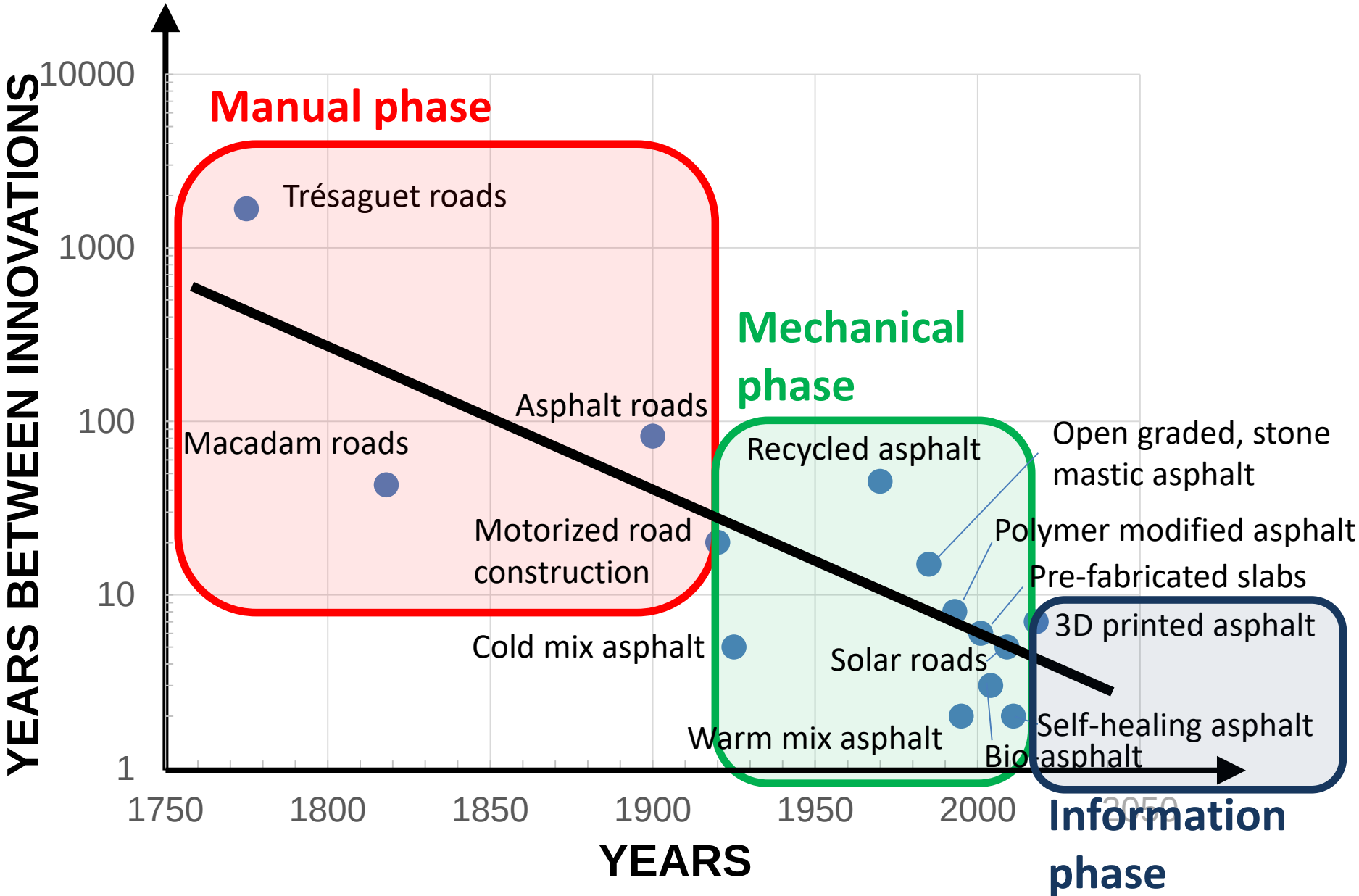
1. ESALs, moisture & temperature recording (sensors embedded in the road)

2. Temporal degradation data acquisition and reduction (Images, profiles, deflections, accelerations, friction, big data models)

3. Predictive (non reactive) Pavement Management Systems; stochastic models

4. Robots for automated maintenance

TIME BETWEEN INNOVATIONS IN PAVEMENTS



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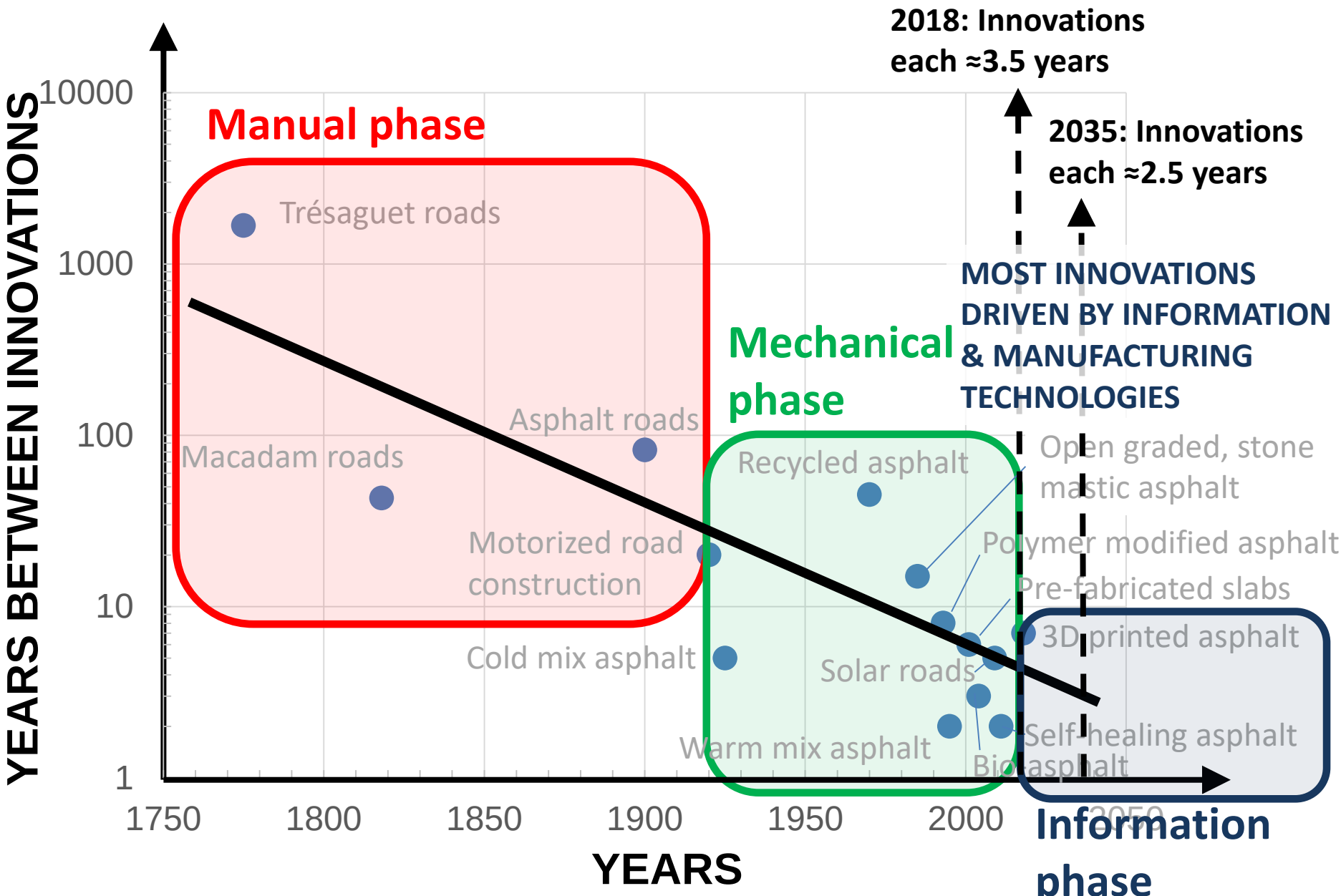
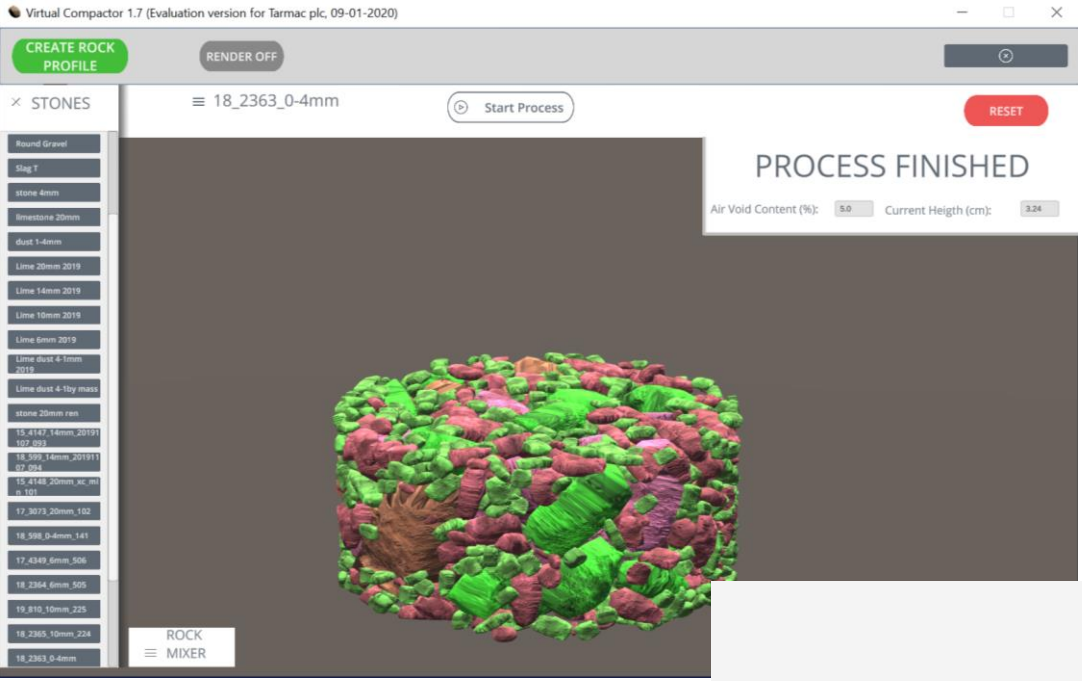
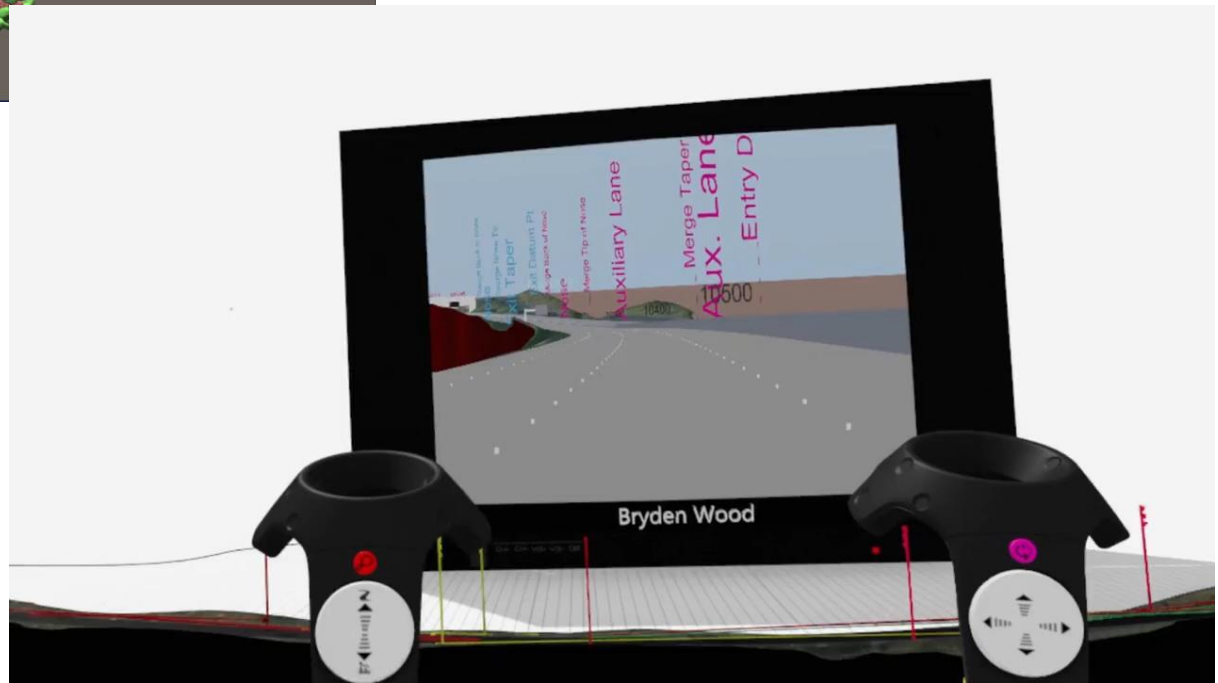


EXAMPLES OF THE USE OF INFORMATION TECHNOLOGY IN PAVEMENTS

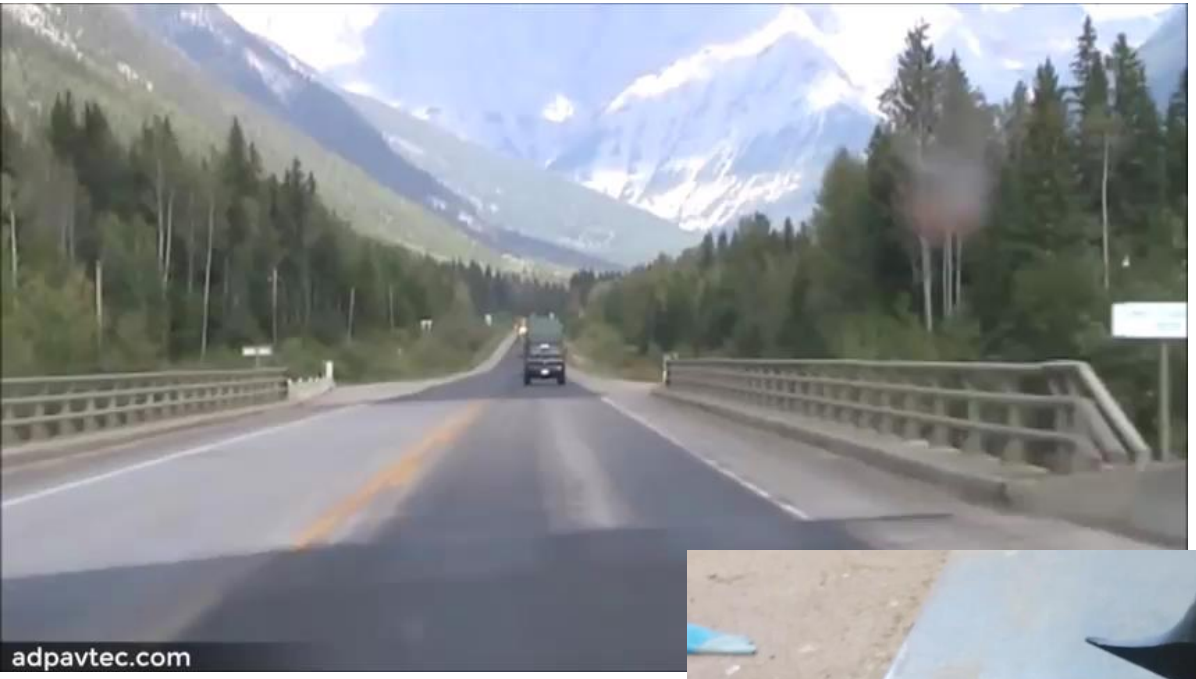


Software to design asphalt gradations as a function of the air void content.

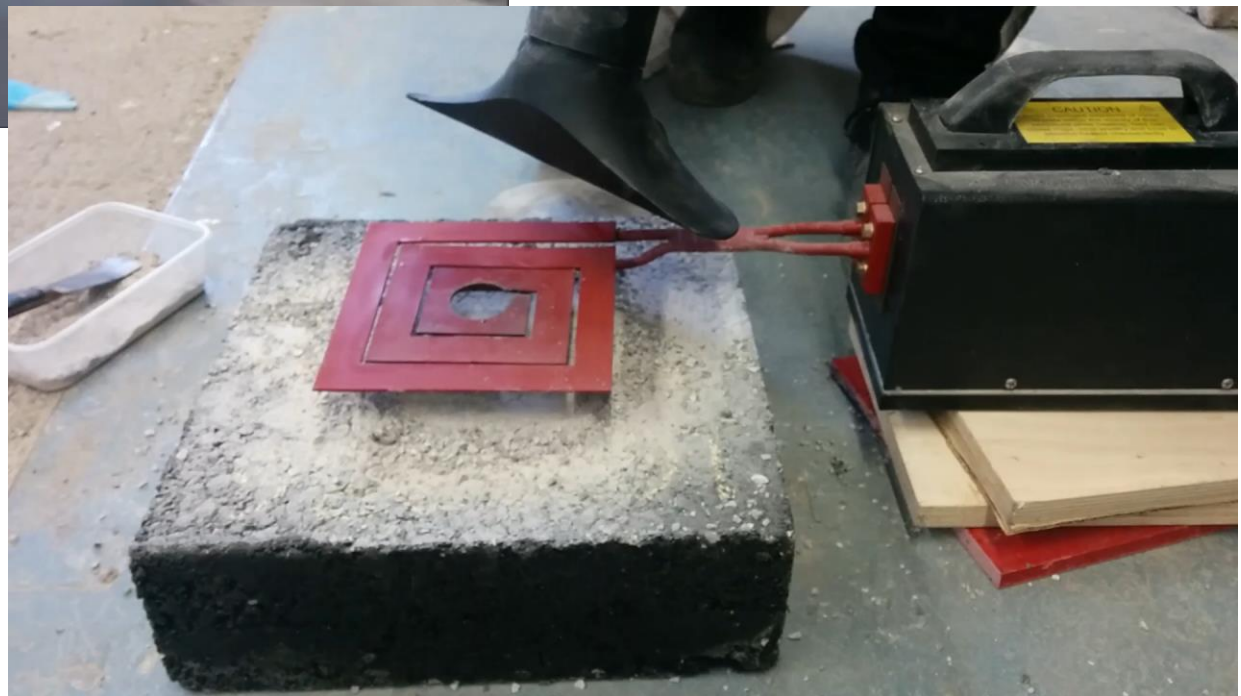
2019. Rapid Engineering Model (REM), Bryden Wood



EXAMPLES OF THE USE OF NEW MANUFACTURING TECHNOLOGIES IN PAVEMENTS

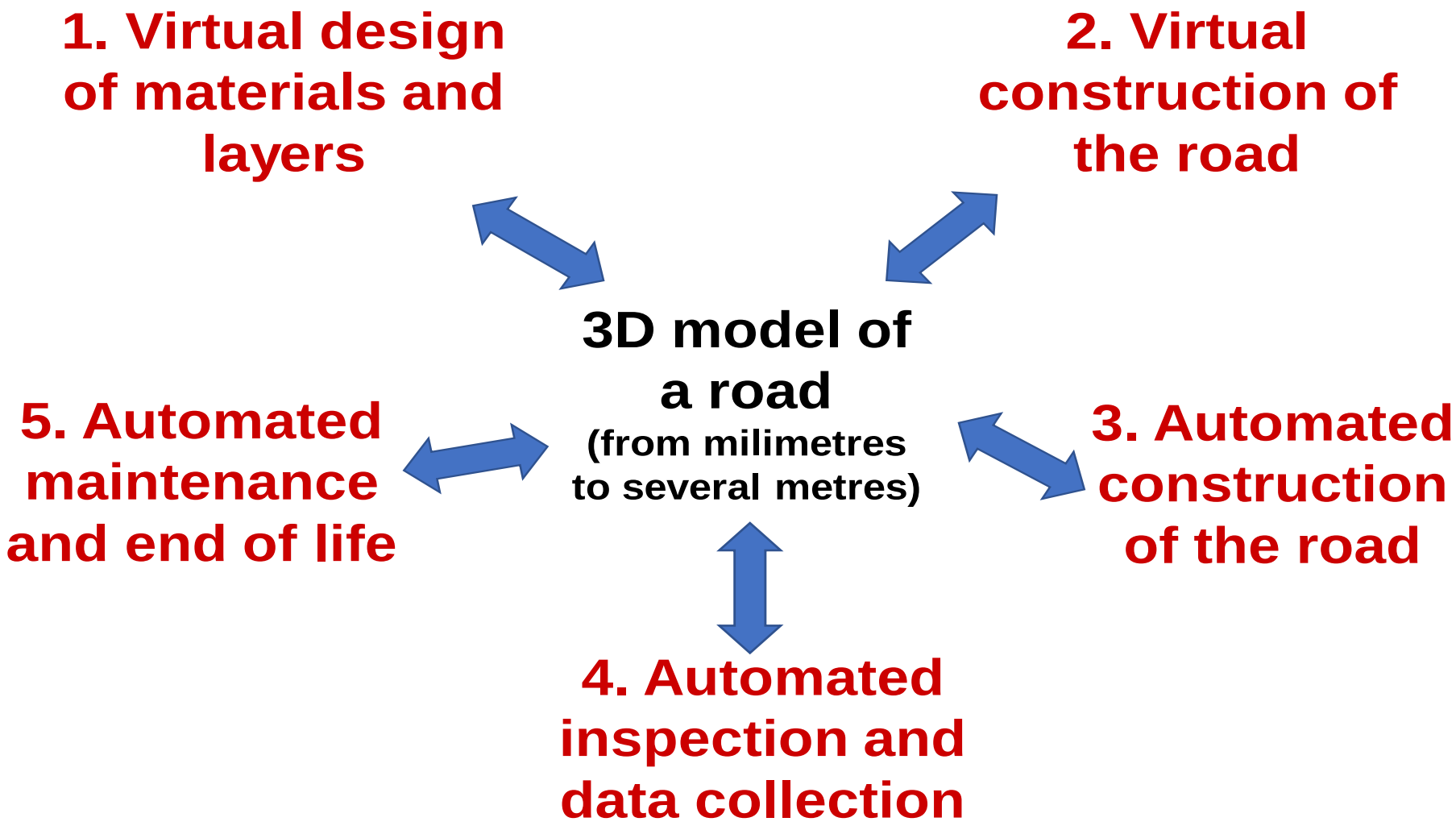


2015. 3D asphalt paver



2018. Selective heating of asphalt layers

A vision for the construction, design and maintenance of roads



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UAVs for infrastructure inspection and maintenance

Dr Bilal Kaddouh

Lecturer in Aerial Robotics

School of Mechanical Engineering

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• Fire and Forget

Robots designed to operate indefinitely, performing inspection, repair, metering and reporting tasks (e.g. robots operating in live water mains)

Perch and Repair •

Remote inspection and maintenance of structures at height (e.g. bridge inspection)

• Perceive and Patch

Swarms of vehicles for autonomous inspection, diagnostics, repair and prevention of defects (e.g. potholes)

Plunge and Protect •

Autonomous robots with the ability to perform underwater or underground infrastructure inspection, repair, and preventive defect maintenance.

• Construct and Confirm

Coordination of robot teams to build/print, finish and certify infrastructure from CAD models using environmentally friendly building materials.

Dismantle and Dispose •

Advanced manipulation in extreme environments to manipulate, cut, separate, and unfasten structures (e.g. nuclear de-commissioning)

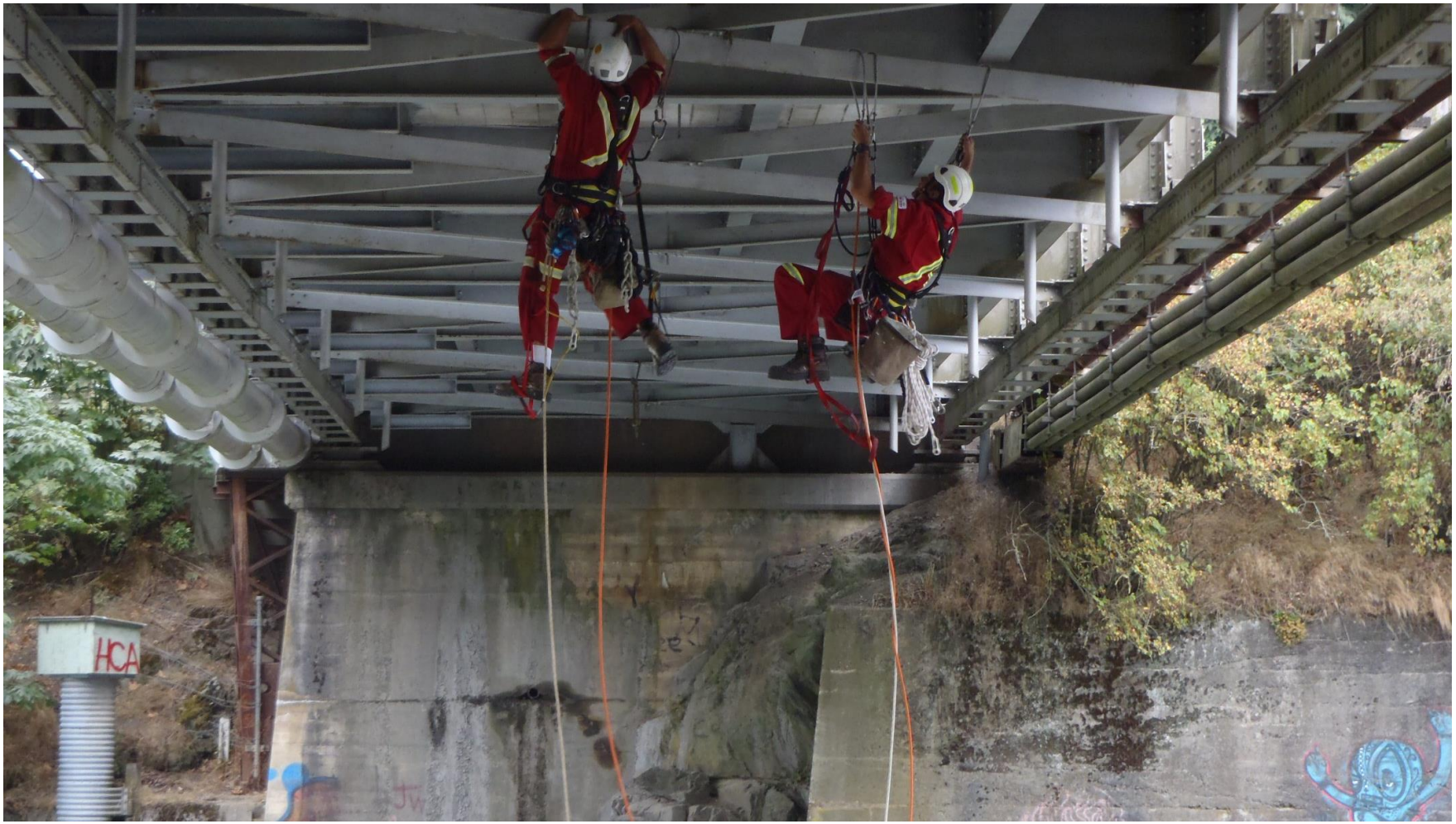
Data and Decisions

Create, process and interpret data securely for effective, verifiable and trustworthy operation of robots interfaced through advanced communications with the smart city (e.g. robots to remotely augment building information models through the cloud).

UAV Opportunities in Self-Repairing Cities

- Inspection
  - High structures (cellular towers, buildings, lampposts…)
  - Transportation structures (roads, bridges, rail/tram…)
  - Energy and water supply (reservoirs, wind turbines, power lines...)
- Maintenance and Construction
  - Direct involvement (Deposit material, manipulate the environment…)
  - Supporting role (Provide sensory feedback, transport equipment …)
- Site Management
  - Support management of manned assets
  - Autonomous management of robotics assets

UAVs for Inspection


HCA

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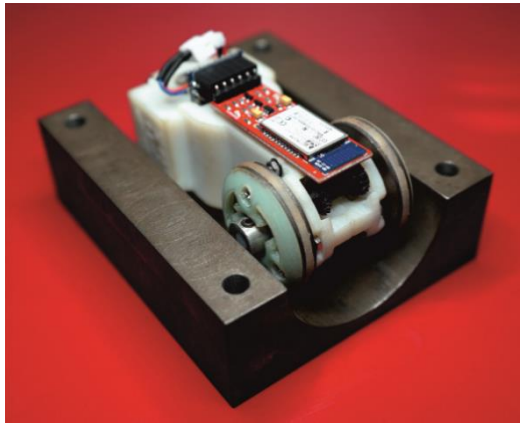
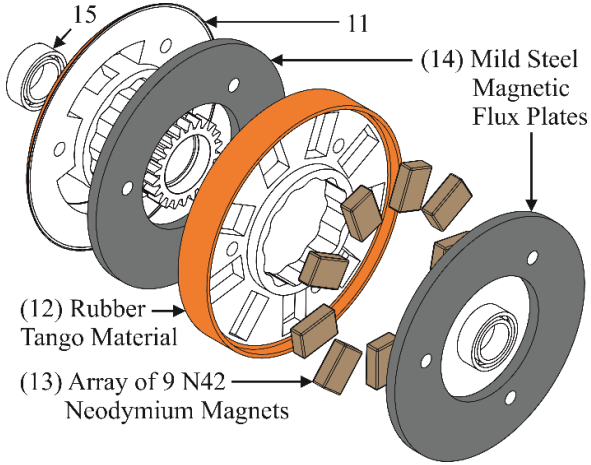
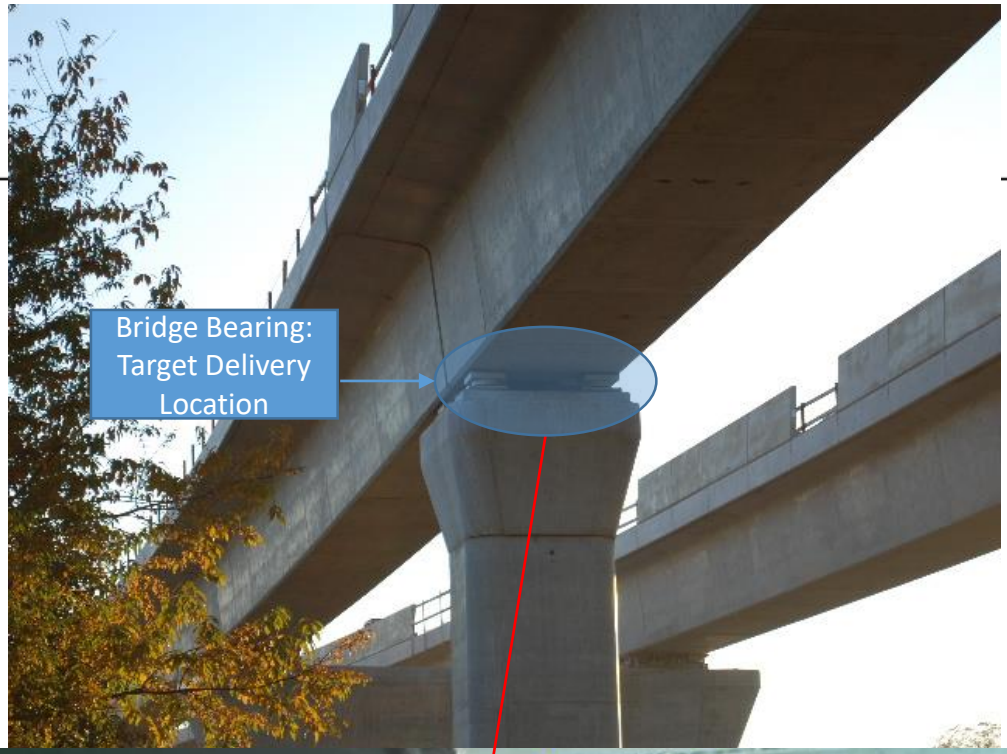
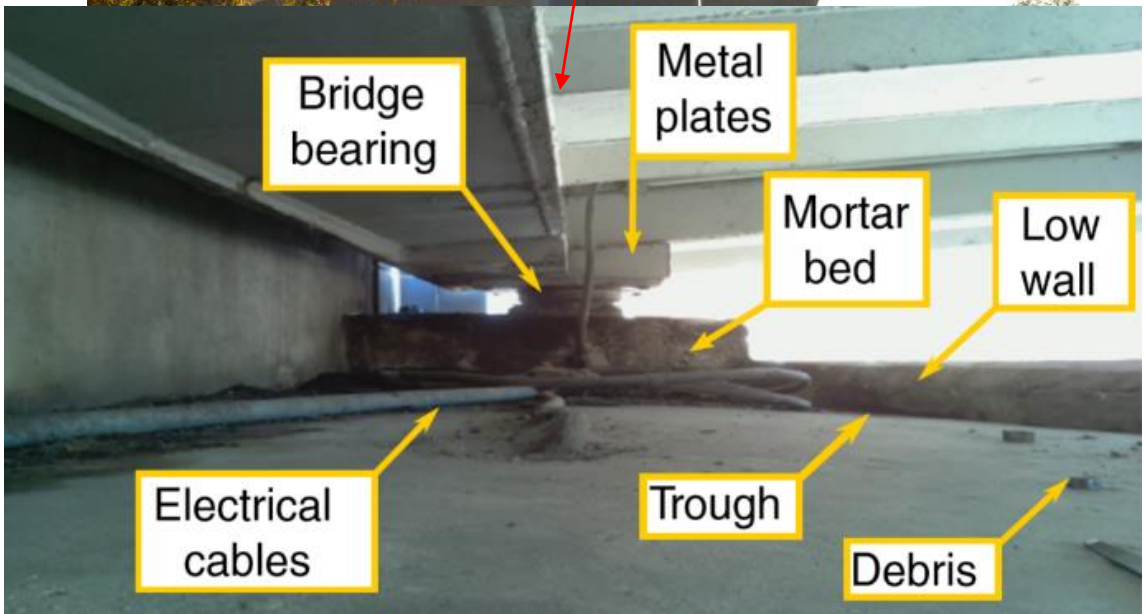
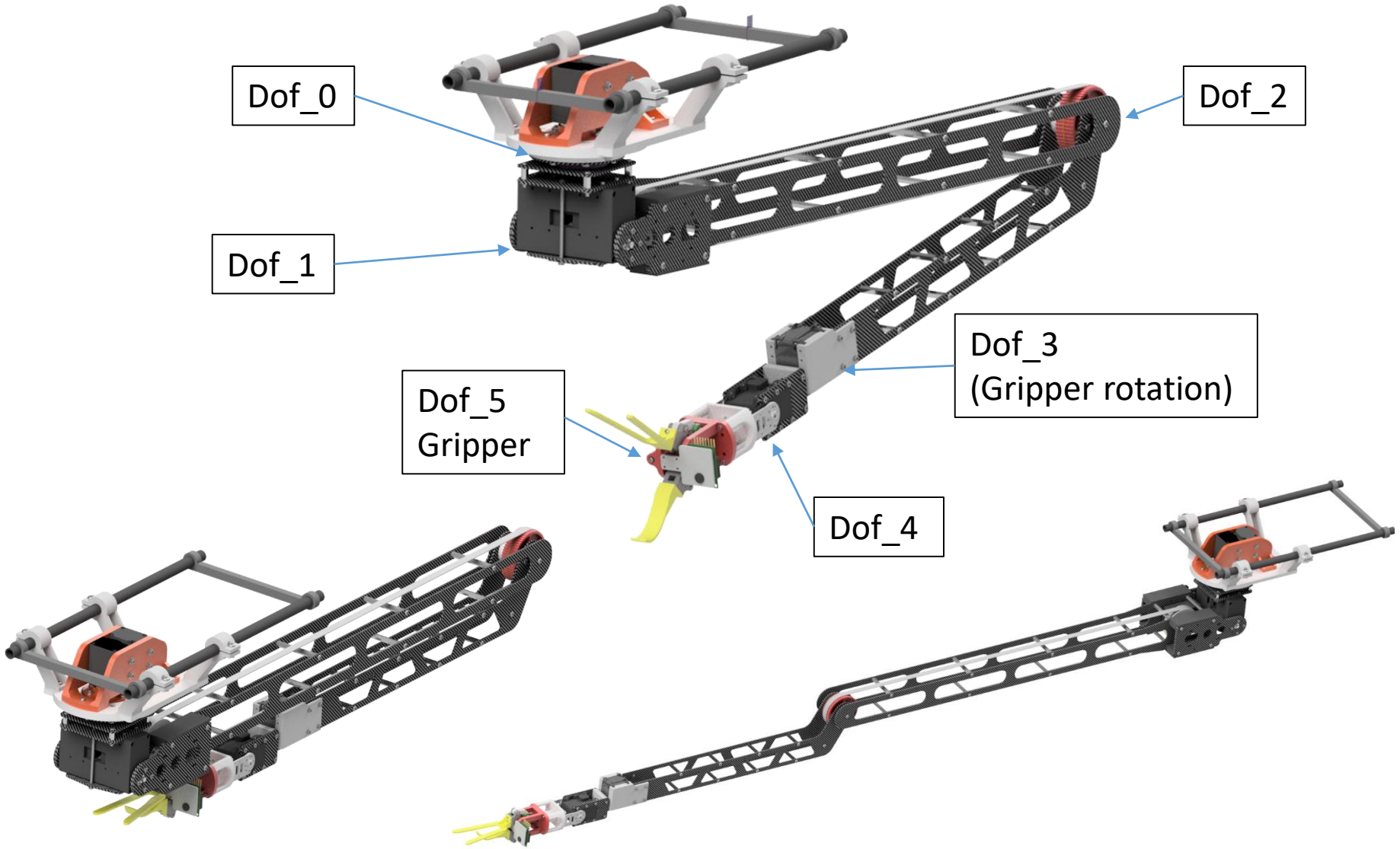


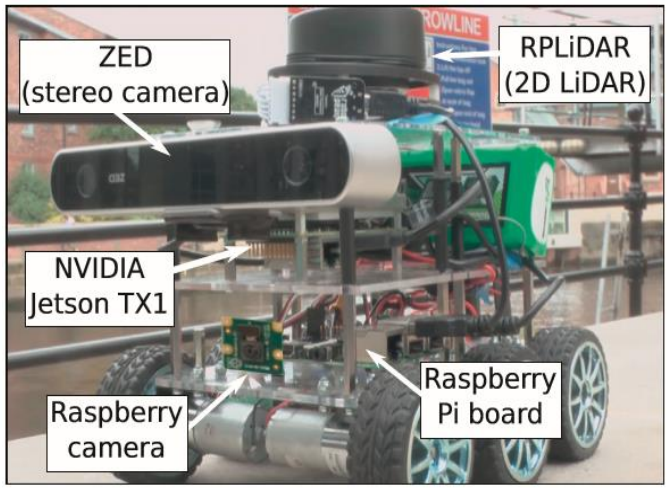

15
11
(14) Mild Steel
Magnetic
Flux Plates
(12) Rubber
Tango Material
(13) Array of 9 N42
Neodymium Magnets

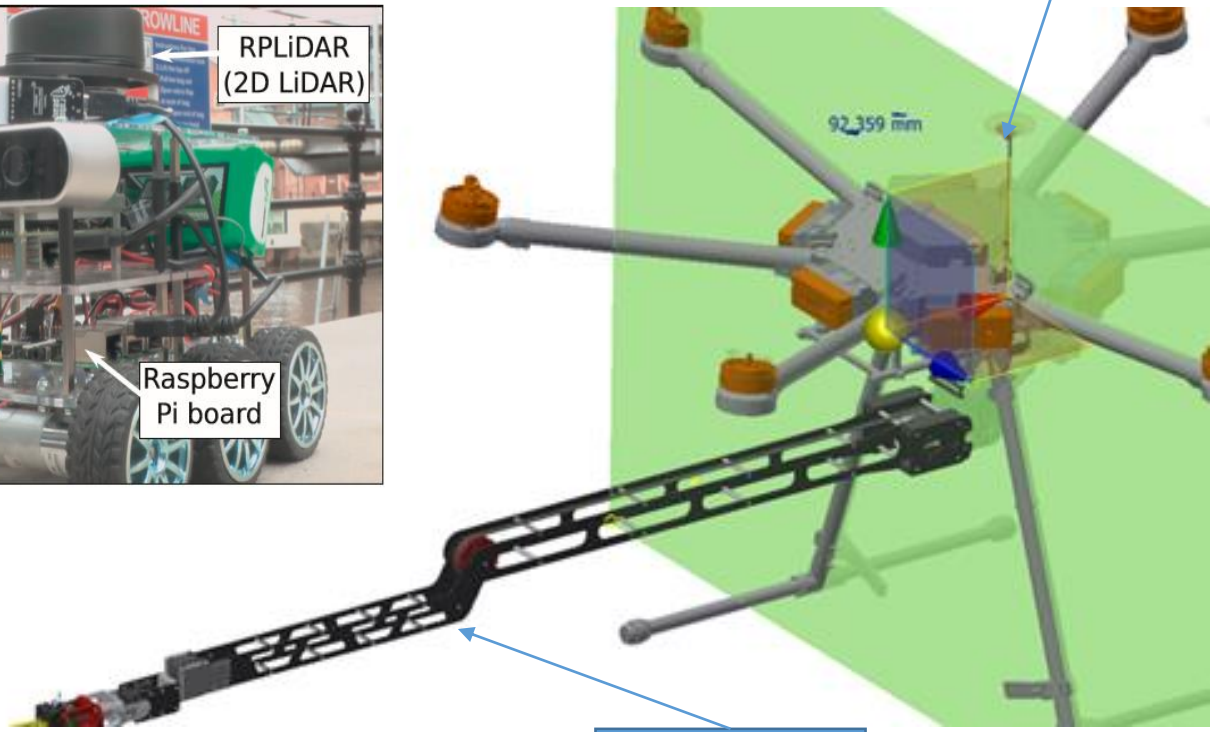
https://www.youtube.com/watch?v=p4UuHPHbedg


Bridge Bearing: Target Delivery Location


Bridge bearing
Metal plates
Mortar bed
Low wall
Electrical cables
Trough
Debris


Dof_0
Dof_1
Dof_2
Dof_3
(Gripper rotation)
Dof_5
Gripper
Dof_4



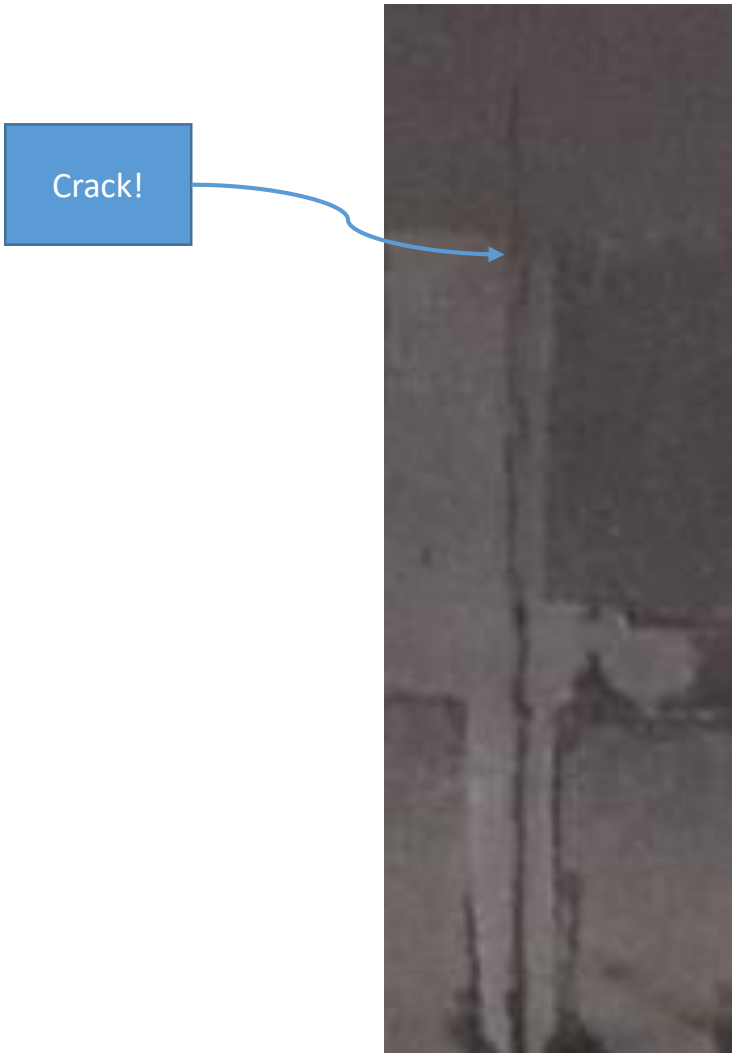


UAV equipped with LIDAR, RADAR and Stereo Camera for separation maintenance.

UAV capable of interaction with solid structures

Inspection UAV

- Visual inspection system based on ZED camera and Jetson TX1 embedded system.
- The system has the ability to detect crack and potholes and build a 3D model of the detected anomaly in real-time.
- Allows inspections of high structures.
- The drone has the ability to detect defects as part of an autonomous infrastructure maintenance operation.


Crack!

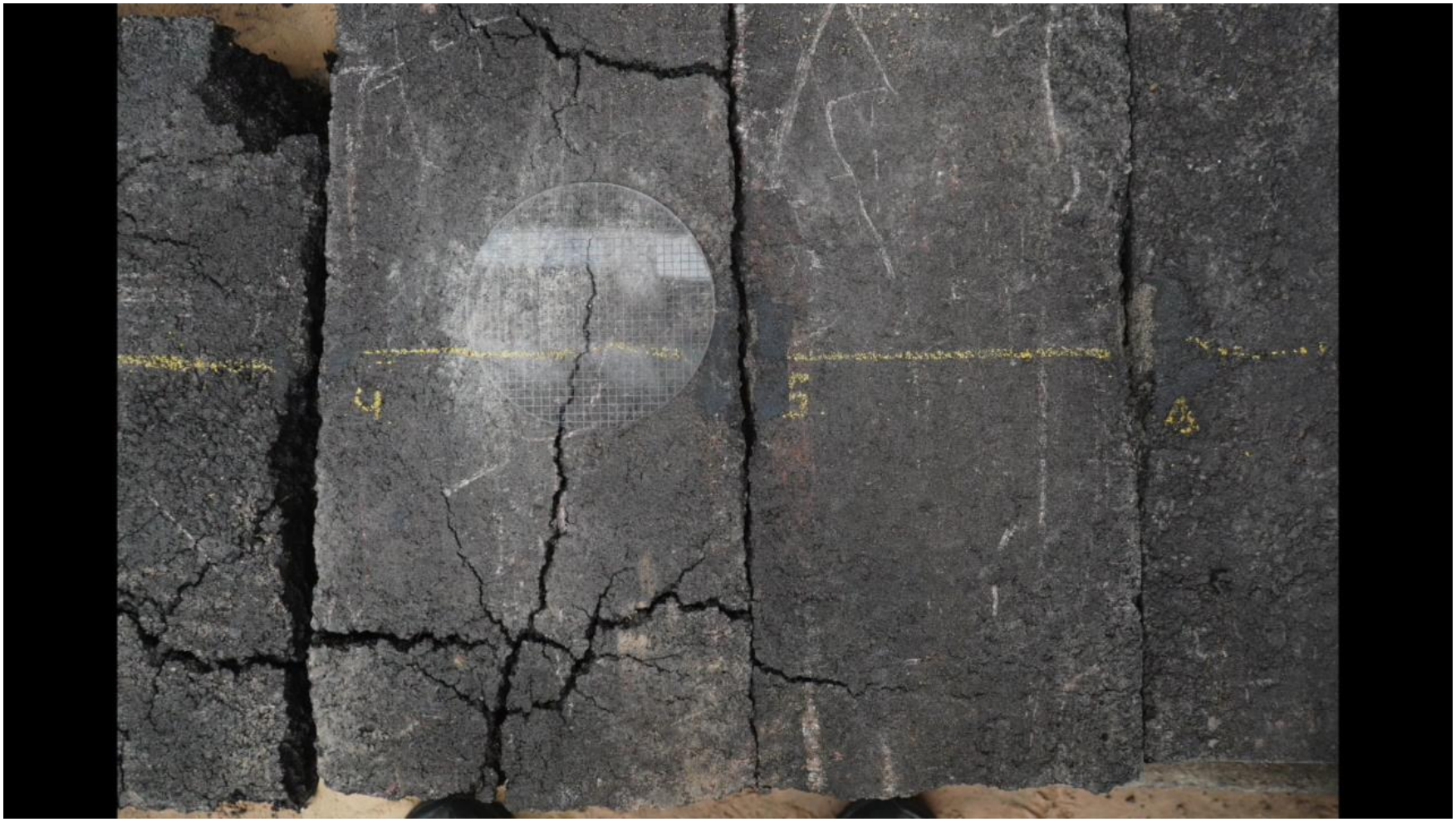
UAVs for Maintenance


3 WAY CONTROL
WAIT HERE
UNTIL GREEN
LIGHT SHOWS


SAFA


SAFA

https://www.youtube.com/watch?v=mcK1xGfDWg0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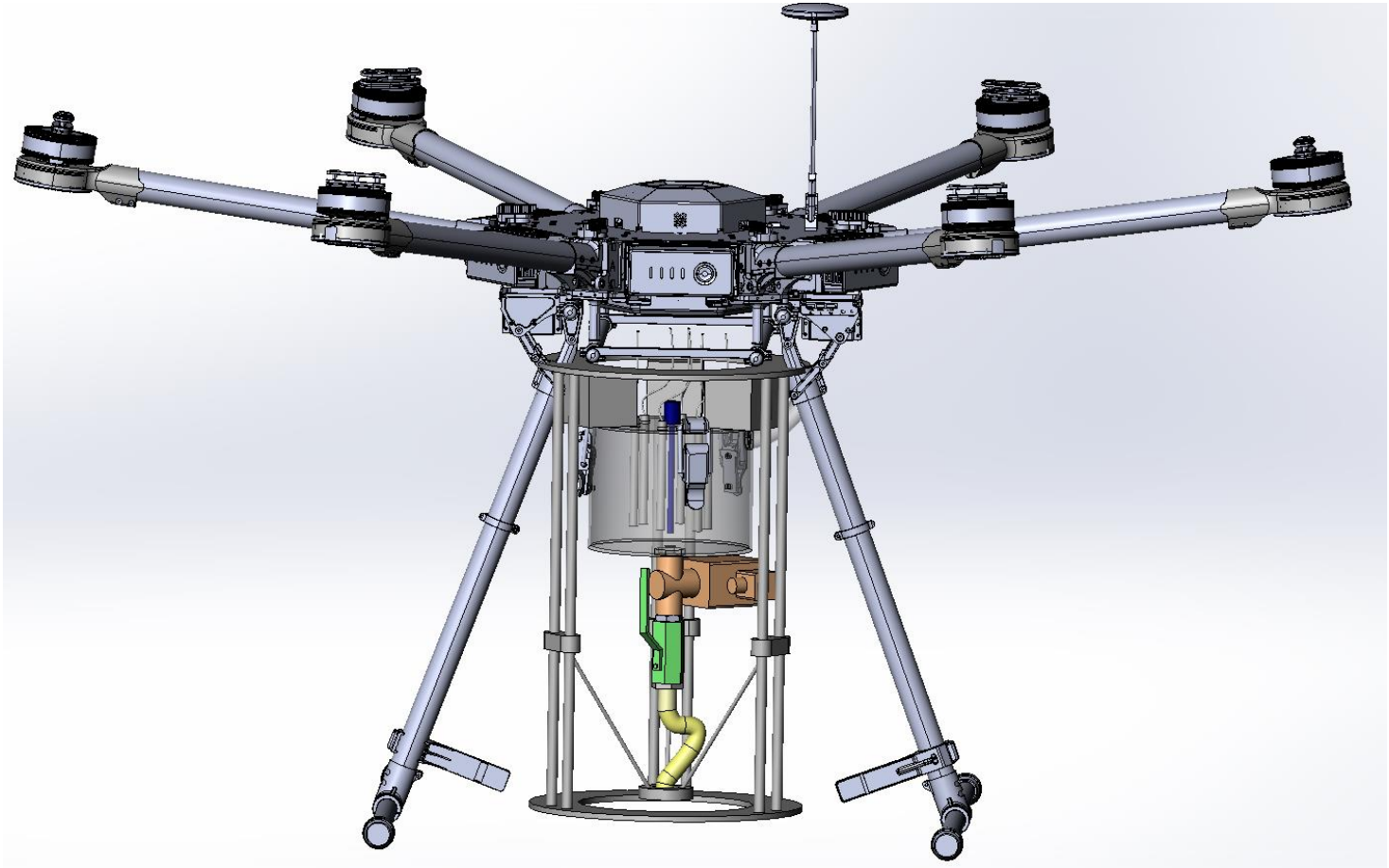
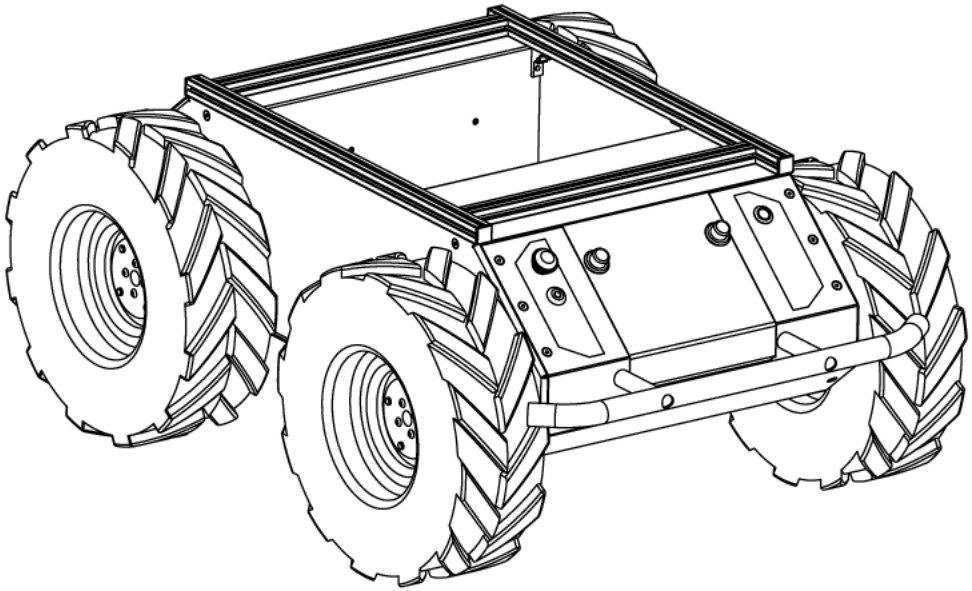
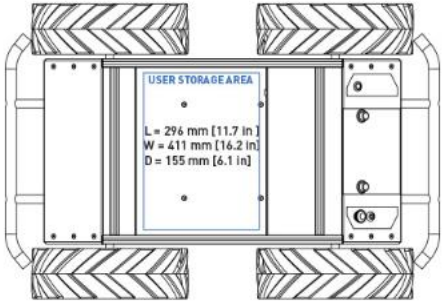
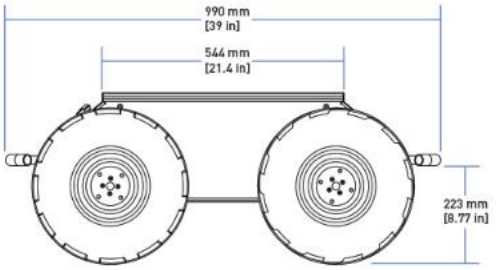


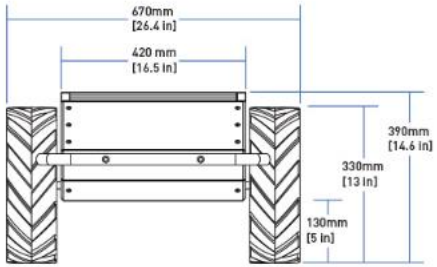




TOP



SIDE



FRONT

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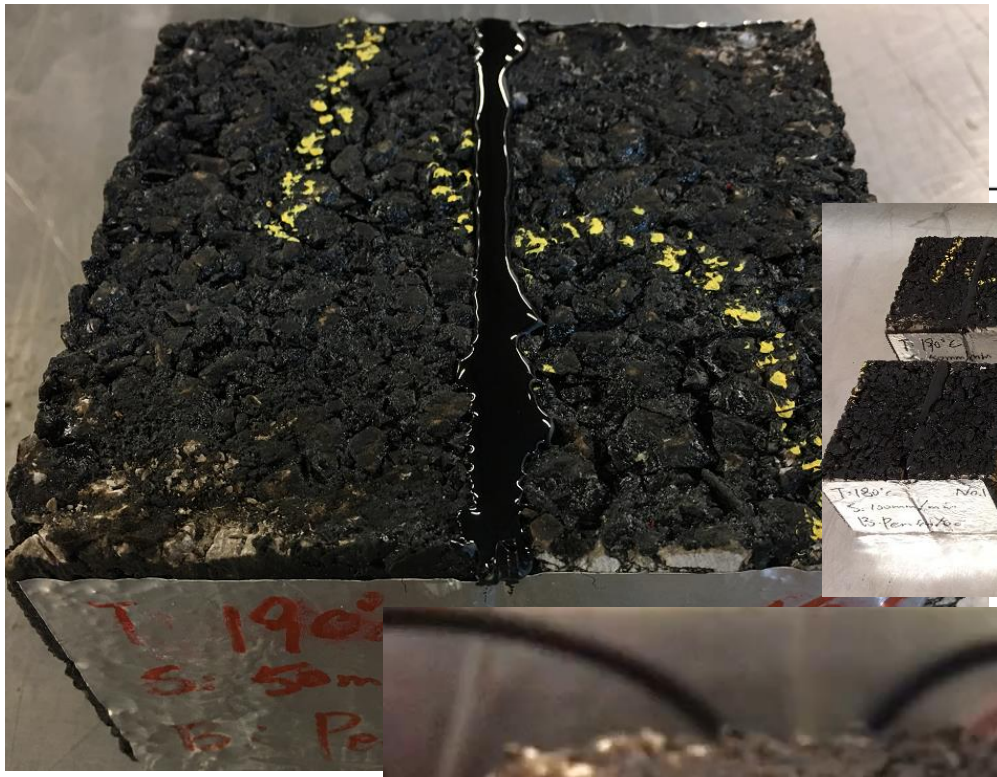

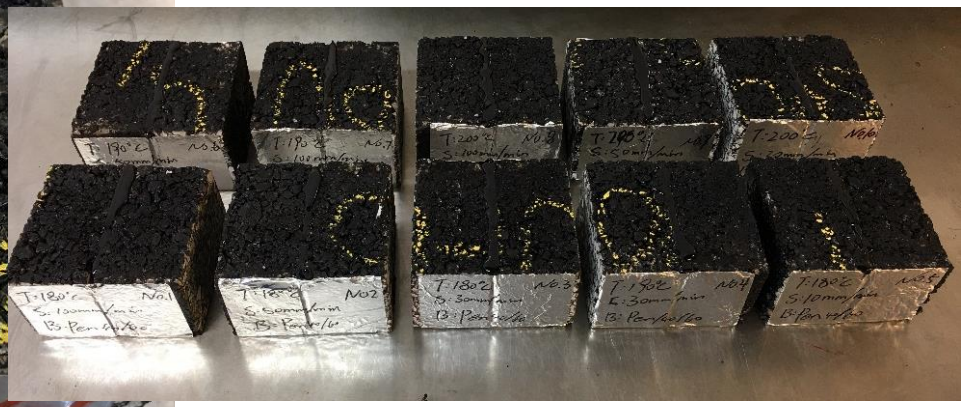

Technical Challenges

- Localization in urban canyons due to degraded GPS signal
- Image processing and object identification
- Endurance for long term operations
- Autonomous path planning and inspection planning
- Resource allocation and management of inspection assets
- Collision avoidance requirements
- Big Data and information management
- Material handling and manipulation
- Limited access to occluded areas

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