Holly Hendry, Ana Cavalcanti,
Cade McCall, Mark Chattington
holly.hendry@york.ac.uk

Design and Verification of Robots in a World of Humans


Department for Business, Energy & Industrial Strategy

THE ECONOMIC IMPACT OF ROBOTICS & AUTONOMOUS SYSTEMS ACROSS UK SECTORS

Final Report

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Robots can be used for maintaining off-shore wind farms, crop harvesting, surgery, nuclear decommissioning and many more. Making our country:

Green and Efficient

Total economic impact of RAS uptake across multiple sectors *in the UK* is estimated to be £6.5 billion by *2035,* but we could increase that!

£6.5bn

But...

RAS uptake is currently limited in many sectors:

Uptake in health and social care is impacted through professionals and patients having a

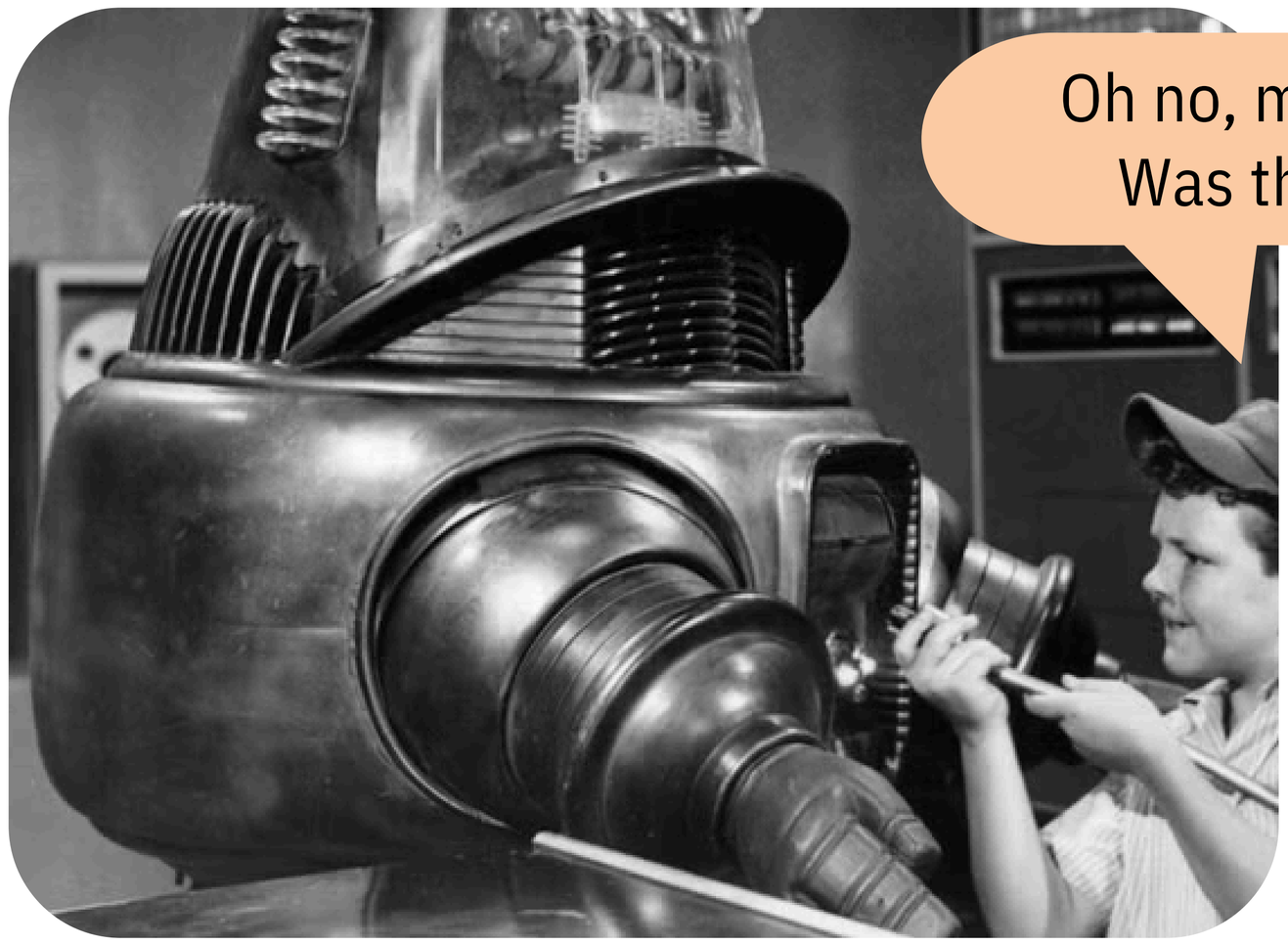
Lack of trust

Energy and infrastructure sectors have

High Validation Standards

All sectors are impacted by funding, as building robotic and autonomous systems has a

High Cost



Oh no, my robot failed! Was that my fault?

How can we test for the safety of human-robot interaction?

How can we predict how a human will interact with a robot?

How can we consider the human, and the robot software, and the robot hardware, and even the surrounding environment?

How can we *prove* that the human-robot interaction is safe?

How can we convince people of that safety?

...

RoboStar with RoboScene enables:

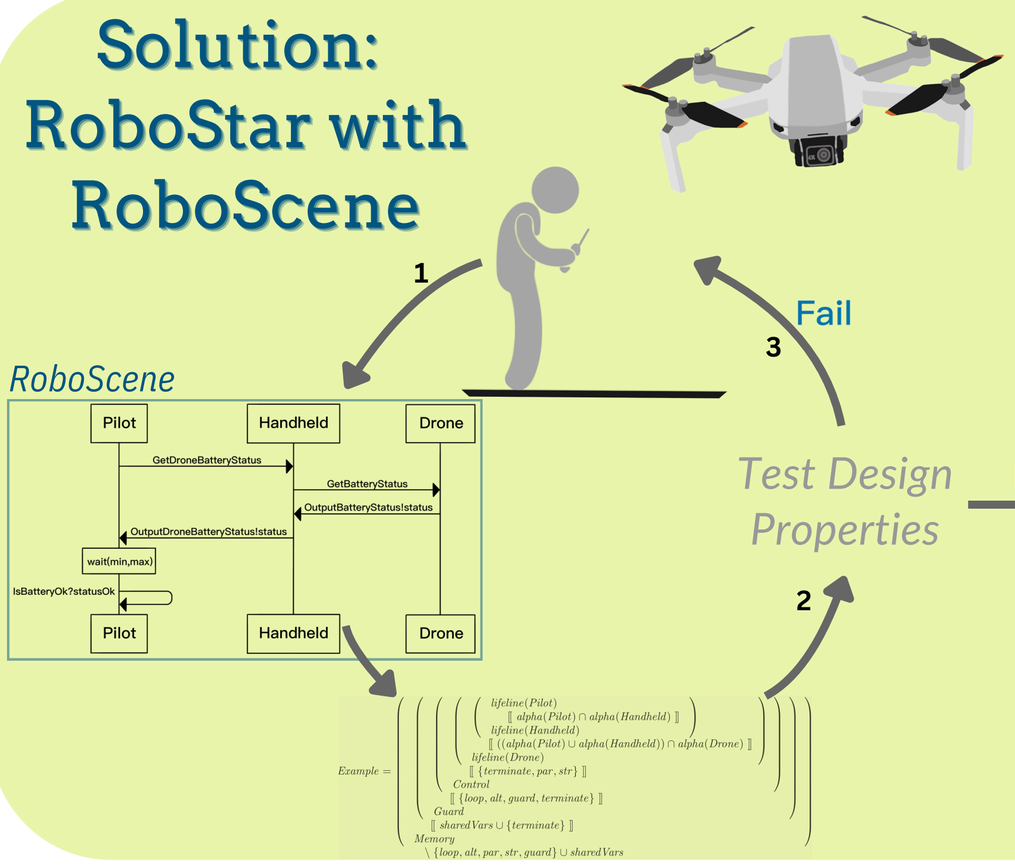
Building trust — Transparency is key for building trust. We need to be able to show how a robot works, especially with humans, in a readable way.

Meeting Standards — Designing with human-behaviour experts, software engineers and roboticists improves the likelihood of a robot being created to meet both engineering and user requirements.

Lowering Cost — Formal verification can reduce costs by proving a design will work before investing time and resources into implementation, even when human-robot interaction is expected.

Key Problem: We need to think about both the human and the robot

Solution: RoboStar with RoboScene



Like any engineer, we need models of the robot to provide evidence of the robots safety and correctness.

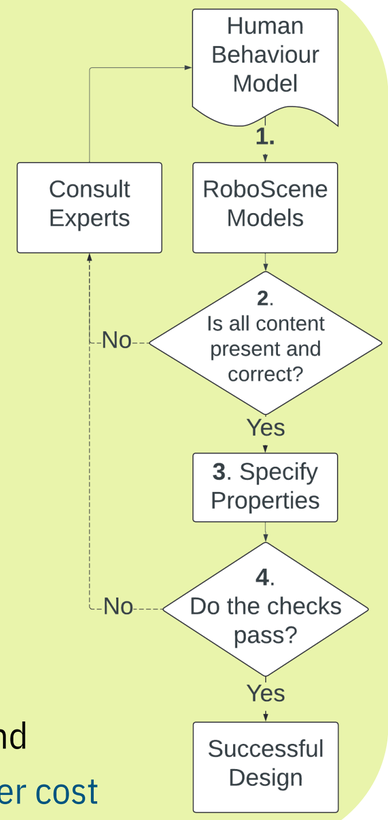
Our approach, considering both human and robot, starts:

(1) by creating a *RoboScene* (our novel language) model of how we expect the robot and human to interact.

(2) From this, we create a mathematical model to test that everything is designed properly through formal verification.

(3) If the tests fail, we look at the design to see if expectations of the human or the robot are the problem, then update the design accordingly.

(4) If the test passes, we have evidence of the robots safety, and readable models for user training.



Our approach involves human-behaviour experts, software engineers and roboticists in the design and creates safer, user-friendly robots at a lower cost

Visit our website to find publications, and seminars, with more information on creating provably safe robots at a lower cost

robostar.cs.york.ac.uk

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