

RCloud Tasking Form – Part B: Statement of Requirement (SoR)

Title of Requirement	Soft Robotics
Requisition No.	RQ0000028640
SoR Version	0.1

1.	Statement of Requirements
1.1	Summary and Background Information
	<p><u>PhD RQ0000028640</u></p> <p>Project Description: In this four-year PhD project, novel computational modelling, 3D/4D-printing and prototyping of multiphase (two/three) Electro Active Polymers (EAPs) will be leveraged to inform the in-silico (computer modelled) design of novel EAP-based soft robots. Cutting-edge Nonlinear Topology Optimisation techniques will be exploited to produce novel effects and reduce the voltage required to achieve actuation of soft robotic materials.</p> <p>Methodology: A new approach with the aim of generating complex electrically induced shape morphing configurations will be investigated. In this new approach, a multi-layered Dielectric Elastomer (DE) device, interleaved with compliant electrodes spreading across the entire faces of the DE, is considered. Then, the careful combination of several DE materials with different material properties (multi-material approach) within each of the multiple layers of the device will be sought through the application of topology optimisation techniques. This ultimately will lead to a heterogenous electric field within the device due to the spatial variation of the material properties within the layers and across them. This PhD will be based on the supervisory team's preliminary proof-of-concept results, which were recently published. The breakdown of the research will be:</p> <p>WP1- Experimental data acquisition using novel Direct-Ink-Writer (DIW) printing technology. A careful campaign of experiments will be designed and carried out in order to manufacture and test a variety of multi-material EAPs, extracting relevant data (stress and electric fields) for subsequent numerical calibration.</p> <p>WP2 - Benchmarking against in-house in-silico software. In-silico simulations will be supported by an experimental programme, with the support of Redacted under FOI Exemption</p> <p>Redacted under FOI Exemption</p>

	<p>WP3 - Development of reduced order modelling approach for fast optimisation and manufacturing. A novel reduced order and fast topology optimisation algorithm will be developed in order to approach novel combinations of EAPs to obtain improved actuation mechanisms in realistic 3D scenarios (twisting and bending).</p> <p>Motivation: Forty years of conventional hard robot technology will imminently be superseded by a new soft robotics era. Electro Active Polymers (EAPs) have been identified as ideal ultra-soft materials for the fabrication of soft robot components due to their ability to undergo highly complex actuation (stretching, bending and twisting) when subjected to electric stimuli.</p> <p>Applications: As actuators (or artificial muscles), EAPs can respond to stimuli faster than natural muscle or conventional motors and their light weight, when compared to conventional actuators, makes them suitable for space platforms, prostheses, exoskeletons, haptic feedback devices, deformable lenses and other system concepts (such as Stacked EAPs) shown to exhibit output forces capable of locomotion/propulsion for lifting/manipulating objects. EAPs can also be exploited as flexible tactile sensors (for machine touch), wearable motion-capture sensors and energy harvesters. Yet the development of EAP soft robots is still in its infancy due to the design bottleneck of selecting from the myriad of interdependent parameters.</p> <p>This PhD studentship will complement two others supported by Redacted under FOI Exemption: (a) by providing experimental data to test and calibrate in-silico modelling and (b) by exploiting more complex multi-material configurations via new homogenised continuum formulations. It will enable full exploitation of a new three-head 3D polymer DIW printer recently acquired by the supervisory team, which can print electrodes and two types of polymer, or three types of polymer.</p> <p>By consolidating this field of research at Redacted under FOI Exemption, this PhD studentship will strengthen our experimental capability and enable unification of the numerical with the practical while also strengthening the relationship between Redacted under FOI Exemption. This PhD studentship is part of a wider plan to combine electromagnetic modelling with time varying control, thermal modelling and, ultimately, Redacted under FOI Exemption internationally recognised fluid-structure interaction modelling, which would lay the foundation for a revolution in soft robotic design.</p>
<p>1.2</p>	<p>Requirement</p>
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Mode of study: full-time

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Payment Plan – RQ0000028640

Progress payment 1 : end of PhD Year 1 (Date TBC) = [Redacted under FOI Exemption]

Progress payment 2 : end of PhD Year 2 (Date TBC) = [Redacted under FOI Exemption]

Progress payment 3 : end of PhD Year 3 (Date TBC) = [Redacted under FOI Exemption]

Progress payment 4 : end of PhD Year 4 (Date TBC) = [Redacted under FOI Exemption]

NOTE: Payment will be annually in arrears, and upon satisfactory completion of all deliverables at the end of each PhD Year.

Additional Definitions

“PHD Year” A consecutive twelve (12) Month period during the Term, commencing on the date that the Authority formally confirms approval of the student in writing

1.3 Options or follow on work *(if none, write ‘Not applicable’)*

Redacted under FOI Exemption

1.4 Contract Management Activities

[Redacted under FOI Exemption]

1.5	Health & Safety, Environmental, Social, Ethical, Regulatory or Legislative aspects of the requirement
	Redacted under FOI Exemption

1.6 Deliverables & Intellectual Property Rights (IPR)					
Ref.	Title	Due by	Format	Expected classification (subject to change)	What information is r deliverab
D – 1	Quarterly Progress and Technical Review (QPTR 1)	T0+3 Months	Presentation (.pptx) or report (.pdf or .doc)	Redacted under FOI Exemption	Redacted under FOI Exemption _____ _____ _____ _____ _____
D – 2	Literature review and project plan:	T0+12 Months	Report (.pdf. or .doc)	Redacted under FOI Exemption	Redacted under FOI Exemption _____ _____ _____
D – 3	Literature review and project plan:	T0+24 Months	Report (.pdf. or .doc)	Redacted under FOI Exemption	Redacted under FOI Exemption _____ _____ _____

D – 4	Literature review and project plan:	T0+36 Months	Report (.pdf. or .doc)	Redacted under FOI Exemption	Redacted under FOI Exemption Redacted under FOI Exemption Redacted under FOI Exemption
D – 5	Final PhD thesis and Final technical presentation	T0+54 Months	Thesis and Presentation (.pdf)	Redacted under FOI Exemption	Redacted under FOI Exemption

1.7	Deliverable Acceptance Criteria
	If upon review of the progress reports and/or the final PhD thesis (as relevant), The Authority does not accept the deliverables, the Supplier shall provide acceptable replacements at no additional cost to The Authority.

2	Evaluation Criteria
2.1	Method Explanation
	Evaluation is based on technical compliance and affordability.
2.2	Technical Evaluation Criteria
	Technical Evaluation already predetermined through internal process
2.3	Commercial Evaluation Criteria
	<p>The commercial evaluation shall be based on the following Pass / Fail questions</p> <ol style="list-style-type: none"> 1. Has the Supplier submitted one (1) full proposal (Technical and Commercial) including all price detail, and has the Supplier submitted one (1) Full Technical proposal which excludes all commercial price information? 2. Has the Supplier submitted the proposal as a Firm price within budget of Redacted under FOI Exemption 3. Are Labour rates and price as per the rates uploaded to RCloud? 4. Has the Supplier submitted one (1) completed copy of RCloud Form Part C – Task Response Form including completed SRGS at Annex A and Notification of IPR Restrictions at Annex B? 5. Has the Supplier completed Research Worker forms as necessary? <p>A fail on any of the above questions will result in your proposal being excluded from further evaluation and consideration</p>