DC Number	DC3
Title of the PhD Project	Data-driven decentralised control design in Active Distribution Grids
Keywords	Power Systems, data-driven control design, supervised and unsupervised learning, active distribution grids
Recruitment organisation	Cyprus University of Technology
Supervisors names and contacts	Petros Aristidou (petros.aristidou@cut.ac.cy)
Scientific context and objectives	Active Distribution Grids (ADGs) are emerging as the building blocks for ensuring the stability and resilience of future power grids. Through the coordinated control of distributed energy resources (DERs), ADGs can support bulk power grids during emergency conditions and improve fault tolerance. To achieve this, centralized and decentralized control algorithms have been proposed, each with different performance benefits and cost requirements. While centralized control algorithms have better performance than decentralized, they have much higher investment cost in monitoring and control infrastructure. Data-driven algorithms can be used to bridge the gap between the two control types [1] – developing decentralized, cheap, easy to employ algorithms that can offer the performance of centralized control schemes. Moreover, the employment of unsupervised learning controls allows to improve the controller performance and robustness during the system operation [2]. In this project, we will investigate the design of decentralized ADG controls with the use of data-driven robust optimization methods and based on historical and forecasted data. Building upon previous expertise [1-3], the objectives of this are to develop a decentralized control design framework for DERs in an ADG using a physics informed data-driven approach, with consideration of network static and dynamic constraints. Moreover, an efficient learning-based predictive control framework will be developed for optimal operation of ADGs, considering the parametric and input uncertainty from the network model, the renewable generation and the consumption. The DC will join the Sustainable Power Systems Lab @ CUT.
Required skills	• A degree in engineering, preferably with a focus on electrical engineering, control engineering, or power engineering - alternatively you have a comparable qualification. • Sound knowledge of electrical engineering or machine learning methods or electric power system modelling and analysis • Experience in at least one higher programming language (preferably Python, Julia, C++, or Matlab). • Ability to work scientifically, independence, flexibility, teamwork and communication skills • Interest in applied research work in sustainable and intelligent power systems • Desire for professional and personal development • Very good knowledge of English
References	[1] S. Karagiannopoulos, J. Gallmann, M. G. Vayá, P. Aristidou and G. Hug, "Active Distribution Grids Offering Ancillary Services in Islanded and Grid-Connected Mode," in IEEE Transactions on Smart Grid, 2020. [2] S. Karagiannopoulos, P. Aristidou, G. Hug, A. Botterud, "Decentralized control in active distribution grids via supervised and reinforcement learning", Energy and AI, 2024. [3] S. Karagiannopoulos, G. Valverde, P. Aristidou and G. Hug, "Clustering Data-Driven Local Control Schemes in Active Distribution Grids," in IEEE Systems Journal, 2021.

This project has received funding from the European Union's
Horizon Europe Framework Programme (HORIZON) under the GA n. 101120278 - DENSE