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## Modular collaborative resilient robots for mining operations

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In the framework of the ROBOMINERS project, we are developing a set of modular collaborative robots that can perform mining operations. The purpose of this work is to face the challenge of taking modular robots out of the academic context and to provide robotic miners with the needed resilience which will be based on four pillars: redundancy, physical reconfiguration, adaptive behavior, and system reconfiguration. To do so, we are working on a scaled prototype based on a highly configurable modular robot that allows the connection between several autonomous robots (modules) and functional submodules (e.g., sensors, mining tools, locomotion devices) where resilience, energy sharing, self-reconfigurability, modularity, and self-awareness capabilities will be tested both in simulation and real-world scenarios. For each robot module, a lightweight and compact main structure is composed of three compartments and three docking ports for each of the robot legs. In each of these compartments most of the electronic components that allow the proper functioning of the robot are located, while in the legs a 4 degrees of freedom closed chain parallel mechanism powered by multi-turn servomotors is responsible of moving the interchangeable end effectors (screws, continuous tracks, legs) designed with a common coupling interface. In addition, an innovative soft telescopic robot arm (Patent pending) is placed at the front of the robot module and allows the coupling of another robot, sensing or actuation module. In parallel to the robot prototype development, a digital twin is being developed in order to test and improve different configurations, localization, mine mapping, and control algorithms techniques before deploying them in the robot.