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Enabling Industry 4.0 approach in Multi-Messenger Astronomy experiments.

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Industry 4.0, with its approach based on digitisation and its tight connection to the Internet of the Thing, represents a reference paradigm that can significantly improve the efficiency and productivity in the construction of experimental infrastructures for science. In this work we propose a methodology based on integrated hybrid systems which combine digital twins of physical phenomena and hardware components together with parts of real apparatuses made of sensors, actuators and software implementations. The peculiarity of the proposed methodology is the orchestration approach which leverages the concept of Virtual Commissioning which allows the design, test and realisation of an infrastructure by means of synergic advancements of virtual representation and the actual implementation. In other words, it will be possible to create a virtually replicated apparatus that can be used for early experimentation, testing and trialing while the actual one is still being assembled. This approach could be actually attractive to large and complex experimental infrastructures for the Multi-Messenger Astronomy which are currently under design or construction, such as new generation underwater and under-ice neutrino telescopes and interferometers for gravitational waves.

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