



# Summer Solstice 2018 Conference on Discrete Models of Complex Systems

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## How difficult is it to self-diagnose? On synchronisation phenomena in various cellular automata

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Reflexivity is a fundamental property of complex systems. This word is in itself an enigma: if we consider an artificial system built by an engineer, it is a huge task to imagine how such a system may have an "image" of itself. If we think about biological organisms, which are usually described as an assembly of cells, it is still a mystery to know how these "systems" can self-diagnose and self-repair. Our purpose is to examine these questions in the context of cellular automata. We will describe mathematical models that allow a group of cells which are all identical to perform various tasks in a decentralised way. We examine phase synchronisation (blinking at the same pace), topology diagnosis (detecting the introduction of defects) and self-correction of  $k$ -colourings (stable states where two adjacent cells have different colours). We underline the limits of the classical deterministic solutions and show how randomness is often an elegant solution to deal with the difficulties.