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Salle du Conseil

Solving NP-complete problems by optic computing

Primitive analog computers, based on the direct measure and manipulation of physical quantities, were supplanted by the advent of digital machines. In more recent times, however, modern technologies make it possible to reconsider the development and use of such analog devices, because of their increased precision and higher speed.

In our work, we focus our attention on modern optic devices which can be combined together to form optical circuits that are actually able to perform computations. We use laser light beams for encoding the elements of a matrix through an ad-hoc light polarization modulation, which is thereafter converted into light intensity amplitude for the detection of the results. Even if our optical circuits are not quantum devices, they are based on the interference phenomenon between the vertical and the horizontal components of light polarization, which is one of the main ingredients in the development of quantum technologies.

Our initial results show that our optical circuits can compete with transistor-based processors on matrix-by-vector and matrix-by-matrix operations, and that there is still room for further improvements. As an application, we plan to use these optical circuits to tackle traditional NP-complete decision problems, such as the subset sum problem, as well as a special case of the distance geometry problem in one dimension.

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