Discussion about the effect of the OAM topological charge on a microwave link budget

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In order to clearly analyze the fundamental changes when dealing with OAM waves, we try to simplify a conventional point to point microwave link. The geometrical configuration is then reduced to face to face, co-axial, annular antenna arrays. Under assumptions of uncoupled elementary sources and ideal Beam Forming Network, the global link budget is derived from an original asymptotic development and analytically exhibits the topological charge effect. A new expression for antenna's Gain is then obtained, surprisingly increasing with the topological charge l. The specific decrease previously discussed by Tamagnone with respect to the distance is found again.

We can then compare the conventional link design, which corresponds to l=0, with sophisticated OAM links that can theoretically be exploited without any interference. This could lead to increase the communication capacity but the equation shows that there is a price to pay. Transposing the l=0 link to a l=1, for instance, clearly decreases the received power, leading to link quality degradation. Thus, maintaining this quality, with same Bit Error Rate for instance, can be achieved with higher emitted power or antenna gain, as usual, but taking into account the OAM specific gain presented in our formula.

We can then conclude that the communication capacity increase, controversially attributed to OAM waves, appears to be limited and the basic configuration and mathematical developments used in this talk are sufficient to clearly describe this limitation.

M. Tamagnone, C. Craeye, and J. Perruisseau-Carrier, "Comment on 'encoding many channels on the same frequency through radio vorticity: first experimental test'," New Journal of Physics, vol. 14, no. 11, p.118001, 2012.
M. Tamagnone, C. Craeye, and J. Perruisseau-Carrier, "Comment on 'reply to comment on "encoding many channels on the same frequency through radio vorticity: first experimental test"'," New Journal of Physics, vol. 15, p. 078001, Jul. 2013.