# Extreme events and nonlinear rogue waves in optics

J. M. Dudley[1], P.-A Lacourt[1], G. Genty[2], F. Dias[3], N. Akhmediev[4]

1. Département d'Optique P. M. Duffieux, Institut FEMTO-ST, UMR 6174 CNRS-Université de Franche-Comté, 25030 Besançon, France
2. Tampere University of Technology, Optics Laboratory, FI-33101 Tampere, Finland
3. Centre de Mathématique et de Leurs Applications (CMLA), ENS Cachan, France
4. Optical Sciences Group, Research School of Physics and Engineering, Institute of Advanced Studies, The Australian National University, Canberra ACT 0200, Australia

**Abstract:**

Extreme value phenomena have dramatic impact in many fields in the physical and social sciences, and are thus the subject of wide scientific importance. The systematic study of extreme value phenomena, however, has been significantly hampered in two ways: (i) the intrinsic scarcity of the events under study and (ii) the fact that such events are often of most interest when they appear in environments (e.g. the ocean) where measurements are difficult. These problems have led to an absence of extensive data sets generated under controlled conditions, resulting in difficulties in studying their generation mechanisms in a clear and quantitative manner.

In this context, however, recent research from the domain of optical physics published in Nature in late 2007 has attracted significant interest [1]. In particular, this research has shown that a convenient laboratory-based system based on nonlinear wave propagation in optical fiber can generate extreme value events with similar statistical properties to the large amplitude hydrodynamic rogue waves observed on the surface of the ocean. These results have motivated a tremendous international research effort in studying how an optical system can be used to directly and conveniently study extreme-value processes. The aim of this paper is to present an overview of our own current research in this area, including recent progress in describing the physics of optical rogue wave formation in terms of nonlinear modulation instability and breather propagation [2-4]. Some aspects of this work have been confirmed by experiments in nonlinear fiber propagation that we will describe in detail. We also consider the particular links between the emergence of a single large amplitude pulse and the propagation of a localised soliton pulse amidst a turbulent low amplitude background [5].

**References:**

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