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Autore	Ludu Andrei
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Sommario/riassunto

Nonlinear science is the science of, among other exotic phenomena, unexpected and unpredictable behavior, catastrophes, complex interactions, and significant perturbations. Ocean and atmosphere dynamics, weather, many bodies in interaction, ultra-high intensity excitations, life, formation of natural patterns, and coupled interactions between components or different scales are only a few examples of systems where nonlinear science is necessary. All outstanding, self-sustained, and stable structures in space and time exist and protrude out of a regular linear background of states mainly because they identify themselves from the rest by being highly localized in range, time, configuration, states, and phase spaces. Guessing how high up you drive toward the top of the mountain by compiling your speed, road slope, and trip duration is a linear model, but predicting the occurrence around a turn of a boulder fallen on the road is a nonlinear phenomenon. In an effort to grasp and understand nonlinear phenomena, scientists have developed several mathematical approaches including inverse scattering theory, Backlund and groups of transformations, bilinear method, and several other detailed technical procedures. In this Special Issue, we introduce a few very recent approaches together with their physical meaning and applications. We present here five important papers on waves, unsteady flows, phases separation, ocean dynamics, nonlinear optic, viral dynamics, and the self-appearance of patterns for spatially extended systems, which are

problems that have aroused scientists' interest for decades, yet still cannot be predicted and have their generating mechanism and stability open to debate. The aim of this Special Issue was to present these most debated and interesting topics from nonlinear science for which, despite the existence of highly developed mathematical tools of investigation, there are still fundamental open questions.