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Using neurofuzzy modeling and information fusion approaches to design an alarm system to avoid exotic phenomena in space weather

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There has been a rapidly increasing reliance on spacecraft systems to meet modern human needs for information transfer and remote sensing. As human presence in space is in an explosive phase, it is expected that the impact of these effects will be quite significant in this and the next few solar cycles. In addition, modern satellite systems and subsystems appear to show an increasing susceptibility to effects of the “space weather”. Space weather is a phenomenon which is caused by radiation and *atomic particles* emitted by the sun and the stars. Space weather is thus determined by the most varied interaction between the Sun and the interplanetary space, and the Earth. It not only affects the functioning of technical systems in space and on Earth, but may also endanger human health and life. Therefore, design of reliable alerting and warning systems is of utmost importance and international collaboration is needed to develop accurate prediction methodologies before the next strikes. It is shown that the cyclic solar activity has chaotic characteristics especially during storm time which depicts the difficulties in long-term prediction of solar activity indices. To design a powerful alarm system, a number of solar activity indices should be long-term predicted and analyzed. In addition, for different kind of storms in different time inter-

vals, different type of combinations for solar activity indices should be considered. On the other hand, data and information fusion deals with the synergistic combination of information made available by various knowledge sources such as sensors, in order to provide a better understanding of a given scene. Information fusion operators can be used to combine information provided by different kind of solar activity indices to recognize a space weather hazard. In this paper, first of all by using the Locally Linear Neurofuzzy (LLNF) models, it is tried to long-term predict different kinds of solar activity indices. After that, information fusion approaches are used to Design a powerful alarm system by combining predicted solar activity indices. Simulation results presented in this paper clearly demonstrate that the performance of the LLNF models with information fusion approaches is superior in comparison with the other well-known methods in alarming space weather hazards.