NARMAX IDENTIFICATION FOR SPACE WEATHER PREDICTION USING MULTI-OBJECTIVE APPROACH

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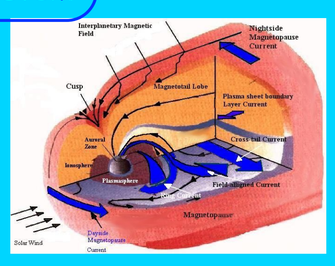
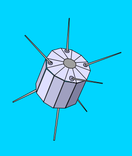
Dynamical-information forecasting of geomagnetic indexes

Magnetosphere is considered as a nonlinear complex dynamical system

Kp,AE,Dst indexes



Dst is sought for as an output of a nonlinear dynamical "black-box"



Data are from OMNI2 database:
http://nssdc.gsfc.nasa.gov/omniweb/
and Kyoto WDC for Geomagnetism:
http://swdcdb.kugi.kyoto-u.ac.jp/

Mathematical models

The Guaranteed NARMAX Model (GNM) provides predictions of the Dst index. Its main advantage is that it delivers an increased prediction reliability in comparison to earlier SRI models.

Guaranteed prediction of geomagnetic indexes

Algorithms and software

- Agorithms and software for optimal structure and parameters identification of mathematical models of ionizing radiation have been considered.
- Forecasting mathematical models of ionizing radiation by numerical methods has been tested

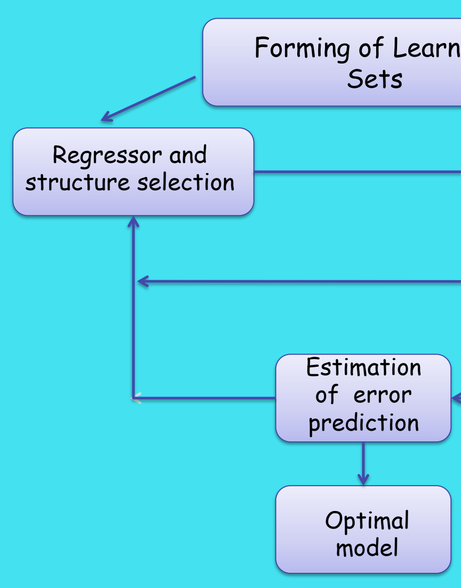


Fig. 1

Risk analysis

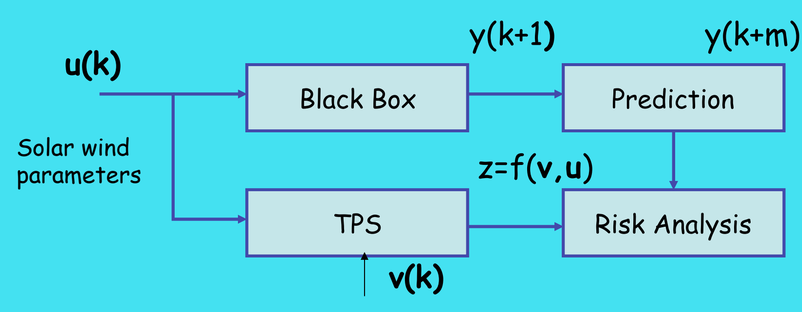


Fig. 2 Prediction and Risk Analysis

Optimization problem with constraints on risk

Let z=f(v,u) be a loss function of a device depending upon the control vector v and a random vector u. The control vector v belongs to a feasible set V, satisfying imposed requirements. We assume that the random vector u has a probability density p(u). We can define a function

$$\Phi_\beta(v,\beta) = (\alpha-\beta)^{-1}\int_{f(v,u)>\alpha}(f(v,u))-\alpha)p(u)du.$$

Optimization model

$$\min \mu(v)$$

$$v \in V, \Phi_\beta(x) \le C_\beta, \Phi_\gamma(x) \le C_\gamma.$$

Hybrid energy storage system based on supercapacitors

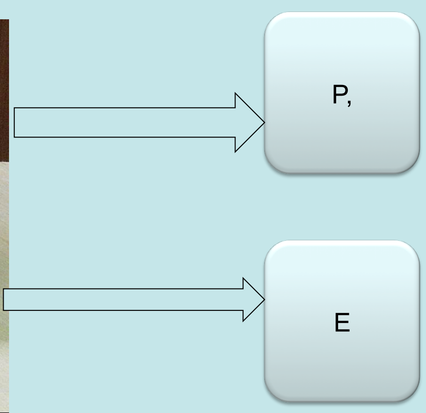


Fig. 3

Voltage decreases of supercapacitors before and after γ-irradiation

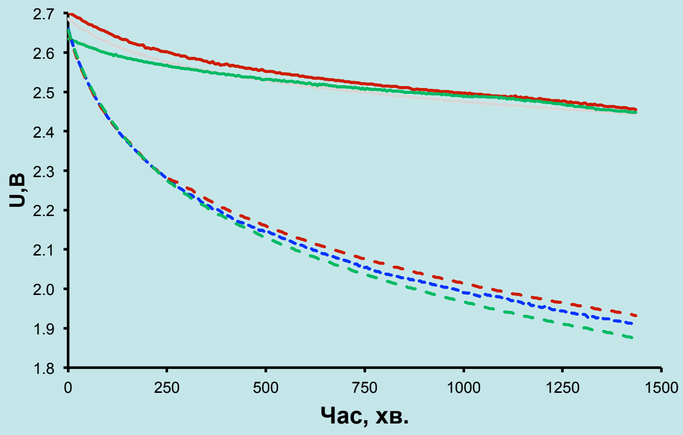


Fig. 4

Output of the diode laser after irradiation by gamma radiation

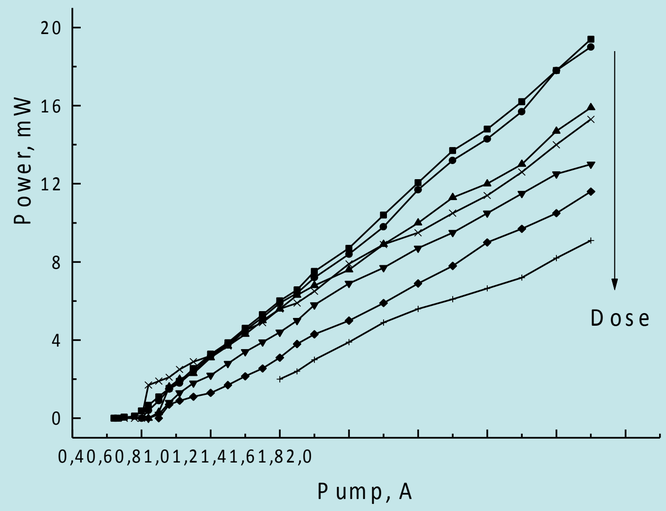


Fig. 5