GLOBAL OPTIMIZATION AND REFLECTIVITY DATA FITTING FOR X-RAY MULTILAYER MIRRORS BY MEANS OF *GENETIC ALGORITHMS*

M. Sanchez del Rio (1) and G. Pareschi (2)

(1) European Synchrotron Radiation Facility, BP 220, 38043 Grenoble Cedex, France
(2) Osservatorio Astronomico di Brera, Via E. Bianchi 46, 23807 Merate (Lc), Italy

ABSTRACT

Genetic Algorithms give a powerful and efficient mathematical technique for the solution of problems involving the maximization (or the minimization) of a given function. They are based on stochastic methods on the model of the natural evolution process: the improvement of a *population* of parameters along successive *generations*. A complete set of initial parameters constitutes an *individual.* The population is a collection of individuals. Each generation is built from the parent generation by applying some selecting operators like, e.g*., mutation, selection and crossover* on the members of the parent generation. The pressure of *selection* drives the population to include good individuals. For large number of generations the best individuals will approximate the optimum parameters.
Genetic Algorithms have already been largely utilized as global optimization techniques for optical designs, like e.g. the design of lens and mirrors. Regarding the case of stacked interferential reflectors (*multilayers*), *Genetic Algorithms* have already been exploited for the design of mirrors in the optical and infrared spectral bands.
We therefore applied *Genetic Algorithms* to two distinct problematics:

- fitting of X-ray reflectivity data measured from multilayer samples in order to extrapolate their structure parameters (e.g. the d-spacing thickness, the interfacial roughness and the intrinsic density of the stacked layers);
- the optimization of the structure design of multilayer mirrors in order to maximize the effective area of X-ray focusing telescopes based on this kind of reflectors.

During this talk we will discuss the approach we have given to the problem together with the presentation of some results obtained in our investigation.