Pramāṇa – J. Phys., Vol. 28, No. 2, February 1987, pp. 97–107. © Printed in India.

# Implementation and comparative study of random sequences for nonlinear least square data fitting

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MS received 19 November 1986

**Abstract.** A numerical study of nonlinear least square data fitting using random numbers from the congruential generator and several quasi-random generators is presented. The results indicate that at least up to five dimensions some of the quasi-random sequences yield better accuracy than the congruential pseudo-random sequence. Some recommendations for selecting the generators of quasi-random sequences are also given.

**Keywords.** Least square data fitting; random search; quasi-random sequences; pseudo-random sequences; global optimization; Gaussian detector response.

**PACS No. 02·60**

## 1. Introduction

In an earlier work (Bandyopadhyay and Sarkar 1985) the authors have shown that the quasi-random search (QRS) technique can be used effectively to fit experimentally observed data (detector responses) with empirical expressions. It has also been shown that the QRS out-performs classical optimization techniques especially when the experimentally observed data are associated with poor statistics. This is because, with the introduction of statistical uncertainty the function to be optimized has a high probability of becoming multi-extremal defined over some multi-variate parameter space, and as such the traditional techniques can suffer severely from trapping in local minima for such problems. This limitation of the traditional techniques is crucial in experimental physics and astrophysics where observed data is often required to be fitted with empirical relations. The quasi-random search technique with importance sampling (Bandyopadhyay and Sarkar 1985) can avoid such trapping with proper choice of the importance function so that the localization of search is achieved rather slowly.

In the present work, we carry out numerical studies to investigate the effective implementation of the method using several quasi-random sequences (QRS) and one congruential pseudo-random sequence in dimensions three, four and five. Further, we compare these sequences to determine their relative merits for nonlinear least square fitting problems. Theoretical estimates of the error bounds of optimization can be obtained by using the extremal discrepancy of the sequence and the modulus of continuity of the function (Niederreiter 1983), but such estimates are not very precise. Furthermore, estimation of the extremal discrepancy of the sequences and the modulus