

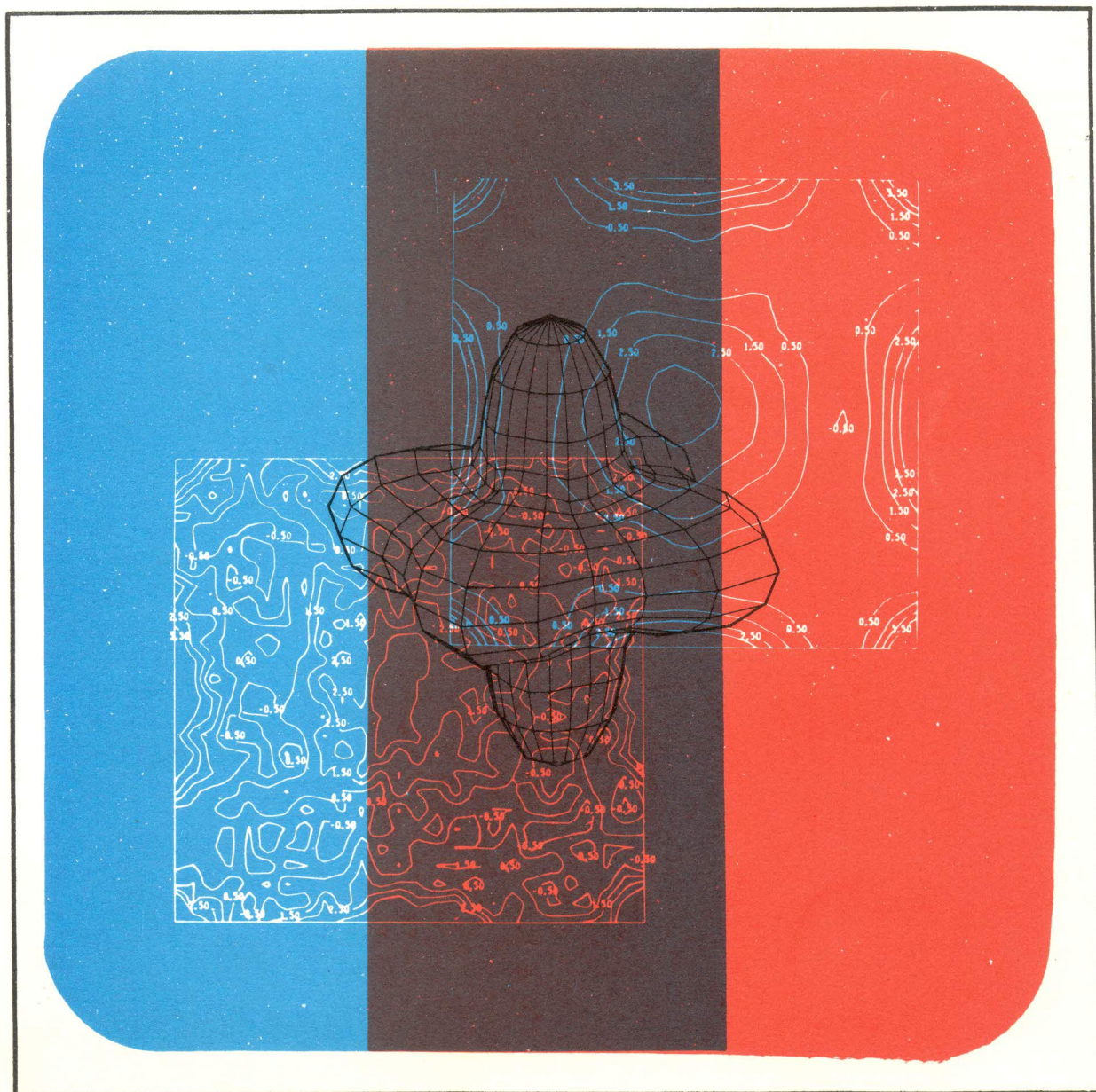
ВЫЧИСЛИТЕЛЬНЫЙ ЦЕНТР
СИБИРСКОГО ОТДЕЛЕНИЯ АН СССР
1986



COMPUTING CENTER
SIBERIAN DIVISION
OF THE USSR ACADEMY OF SCIENCES
1986

« LIDA-3 »

**software library for data
approximation digital filtering
and image processing**



SOFTWARE LIBRARY LIDA-3 FOR DATA APPROXIMATION, DIGITAL FILTERING AND IMAGE PROCESSING

The software library LIDA-3 has a wide range of applicability to many problems connected with interpolation and smoothing of grid functions of one and several variables at uniform or chaotic meshes, as well as in digital signal filtering and image processing.

The essential features of LIDA-3 are:

- its multipurpose organization,
- high speed,
- good diagnostics,
- new methods of data flows organization for mass data exchanges,
- utilization of the new and most efficient algorithms not available in other software libraries.

Main language is FORTRAN-IV. Several subroutines (about 5% of the total volume) utilize the ASSEMBLER code. Volume of the library is 30 000 FORTRAN lines.

LIDA -3 is the latest version of the library, which makes use of the experience obtained from years of successful utilization of LIDA and LIDA-2 libraries in many fields of science and technology such as geology, geophysics, industry, astronomy, digital acoustics, image processing, etc.

The library has two parts.

Section A. DATA APPROXIMATION

The programs of this section are intended for:

- a) the mesh function of one variable:
- interpolation and smoothing by the spline-functions of odd degrees by point evaluations, choice of the smoothing parameter, the simultaneous solution of several problems, generation of the informative meshes;
- interpolation and smoothing by spline-functions of even degree by local integrals, choice of the smoothing parameter; simultaneous solution of several problems;
- construction of the Hermitian spline-approximation by mesh values of the functions and their derivatives, simultaneous solution of several problems;
- interpolation by the ratio of two polynomial splines, separation of the pole singularities;
- construction of the quasipolynomial L-splines, various types of boundary conditions, approximation of fast oscillations and boundary and interior layers, generation of the quasipolynomial finite elements;
- spline-approximation with constraints of the inequality type, isogeometrical approximations;
- the analysis of mesh functions to find the latent laws of the quasipolynomial type;

b) the mesh functions of several variables:

- construction of the interpolating or smoothing polynomial splines at the multidimensional grids with different smoothness with respect to various variables; for the large data volumes - the exchange with the external storage;
- data interpolation or smoothing of the mesh functions at the chaotic meshes by the values of the function and its 1st and 2nd derivatives; choice of the smoothing parameter; for the 2-dimensional domains - generation of the informative meshes (data compression); the number of interpolating conditions - up to 300 per megabyte;
- interpolation (smoothing) of the functions at the chaotic meshes with the help of polynomial finite elements; sparse matrices; choice of smoothing parameter. In two-dimensional case - up to 6 000 points per megabyte, in three-dimensional case - up to 3 000 points per megabyte; the data exchange for large problems;
- the best uniform approximation of the data at the chaotic meshes by generalized ratios; data compression;
- approximation of the surfaces of the three-dimensional bodies satisfying the star condition with respect to any interior ball, by point evaluations and normals at the chaotic mesh on the

sphere; number of interpolation conditions up to 300 per megabyte.

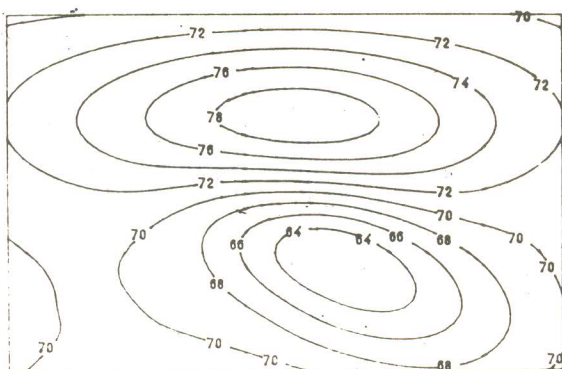
Section B. DIGITAL FILTERING AND IMAGE PROCESSING

Both some classical ways of digital signal and image processing, like Fourier transform, and the original new algorithms are presented here. The latter are based on decomposition of the filter into filters with piecewise-constant kernels and other simplest ones. These filters give the improvement and acceleration of data treatment.

The programs of section B are intended for:

- high-speed digital signal and image processing by the filters with given frequency responses;
- the assembly of the bandpass filters of high fidelity;
- restoration of the signals and images when the device function is known;
- digital processing by the filter with non-stationary frequency responses;
- the efficient approximation of the reject filters;
- filtering, preserving (or suppressing) of the given system of the polynomials, trigonometric, exponential functions, or the spline-functions of given degrees and defects;
- filtering, suppressing of the echo-noises, when the distances to the obstacles and reflection coefficients are known;
- other functions.

a)



b)

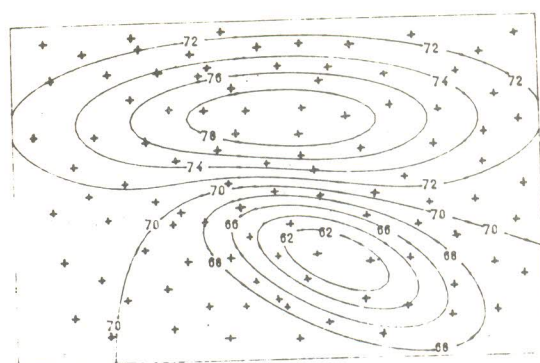
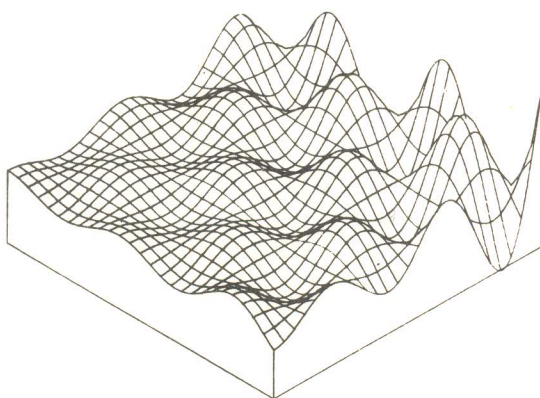


Fig.1 Interpolation at the chaotic mesh

a) exact function b) spline-interpolant

a)



b)

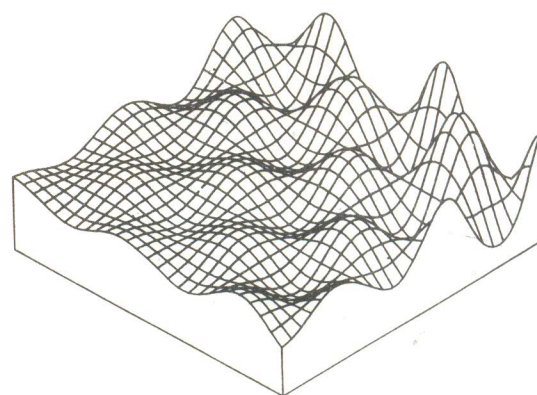


Fig.2 Smoothing at the chaotic mesh

a) exact function b) spline-function

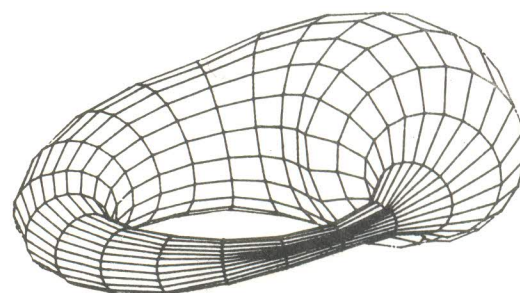
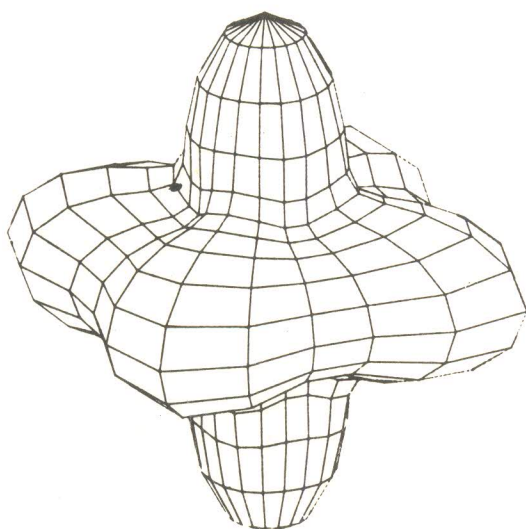


Fig.3 Surfaces of 3-dimensional bodies



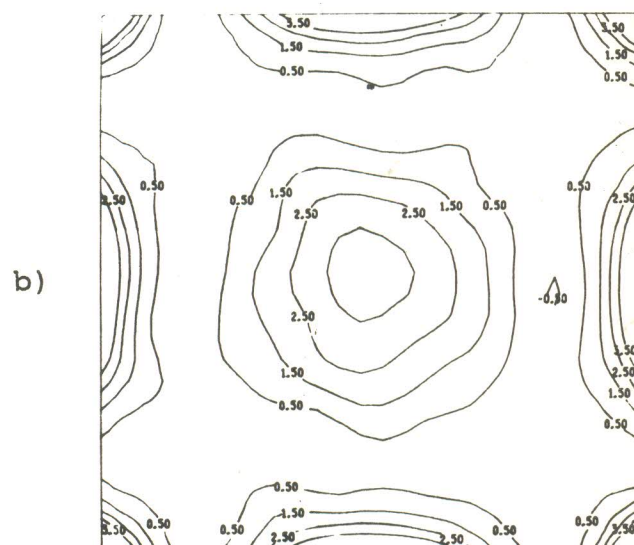
Fig.4 Image correction by given device-function

a) initial image

b) restored image



a)



b)

Fig.5 Filtering preserving cubic splines

a) initial field

b) result

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