PLASMA DIAGNOSTICS DATA PROCESSING SOFTWARE

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The idea of *complex interferometry* as a potentially powerful diagnostical tool allowing for simultaneous recording of up to three physical quantities into a single detection channel (phase shift, intensity changes along fringes and fringe blurring) was introduced in mid eighties by one of the authors (M. Kálal) and its principles have been later summarised in the overview paper [1]. A feasibility of the method was firstly demonstrated on computer generated data [2]. Shortly after that first complex interferograms were obtained experimentally from measurements of spontaneous magnetic fields generated in laser-produced plasmas and successfully analysed [3] thus helping the technique to be recognised by the scientific community [4].

Due to the necessity to employ the fast Fourier transform as well as the Abel inversion [5] for the complex interferogram analysis it became obvious that this technique would be rendered useless in practice unless some decent data processing software would become available.

The first algorithm was coded at that time in FORTRAN 77 to work on the VAX 780 series of minicomputers. The absence of integrated graphical output combined with no pointing device belonged to major drawbacks of this software package making its use rather cumbersome.

The next (and much more user friendly) version of the analysing software was written several years later in the C programming language for the Commodore AMIGA range of personal computers with a large number of analysis performed [6]. The obvious disadvantage of this version was a very limited base of available computers. Thus the need for some more common platform became evident.

The new graphically oriented 32-bit operating system Windows 95 (Windows NT) was found well suited for this purpose both from the point of its performance as well as the availability of the platform this operating system is working on. The 32-bit version of the Borland Delphi was selected as reasonably suitable development environment [7].

In our design and implementation of the program itself we tried to fully adhere to principles of object oriented technology. The object model allows for simple future upgrades of functionality and variability of the program and greatly simplifies its maintenance. As the kernel of the program consists of large data matrix manipulation a set of data classes representing real physical quantities (density, magnetic field, phase shift, etc.) was introduced. Every such data class encapsulates matrixes worked upon together with functions performing operations on these matrixes. General functionality is implemented in an abstract data class securing loading and saving of data, application of different filters, transformation of data, visualisation in 2D and 3D etc. Every instance of the data class contains the information about its status (e.g. it is possible to find out which part of the original data is represented by the current status of the object).

To demonstrate the programme itself let us present several pictures and screen shots.
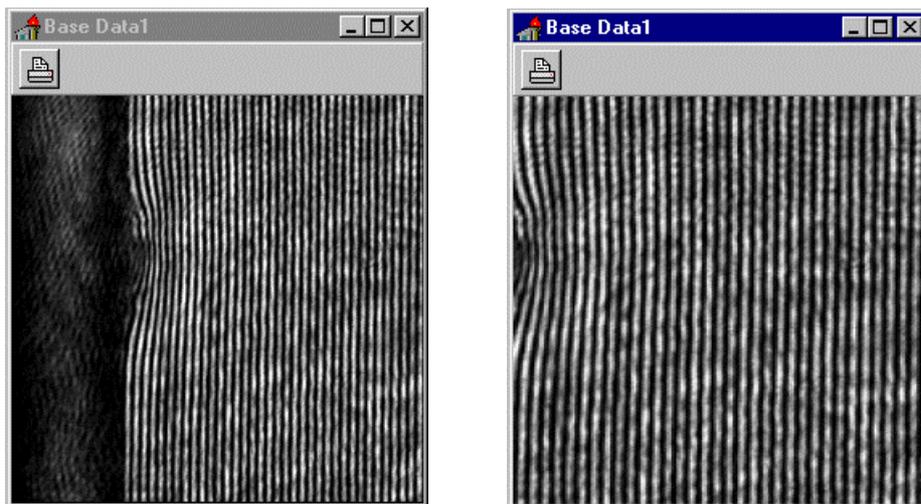
Fig. 1: Original data obtained from the CCD camera (left) and the region selected interactively by the user and resized automatically to the 256 x 256 matrix for subsequent processing (right).
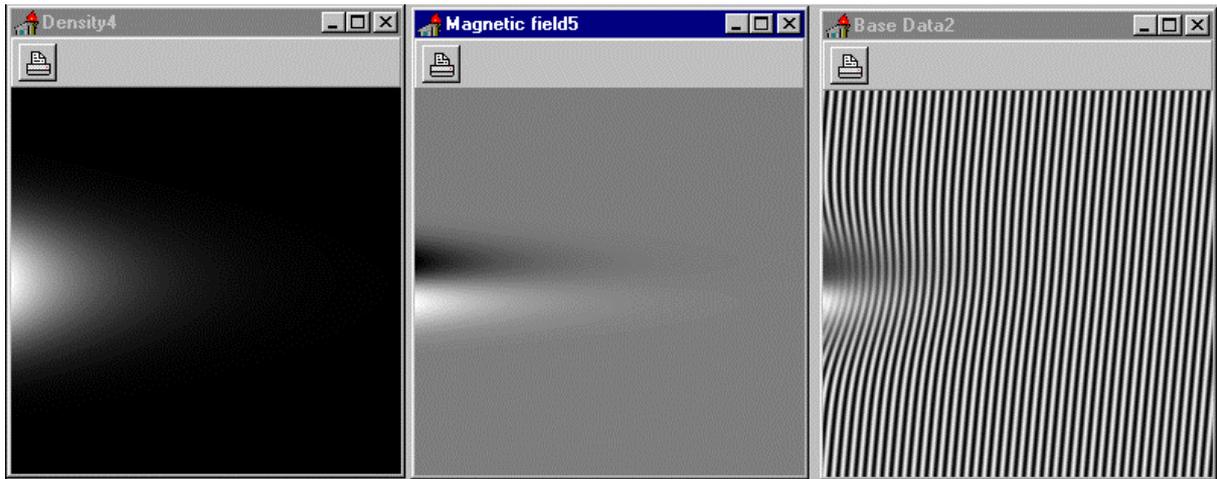
Fig. 2: The computer generated density profile (left) and magnetic field profile (middle) with the corresponding complex interferogram (right). Please note the fringe blurring applied.
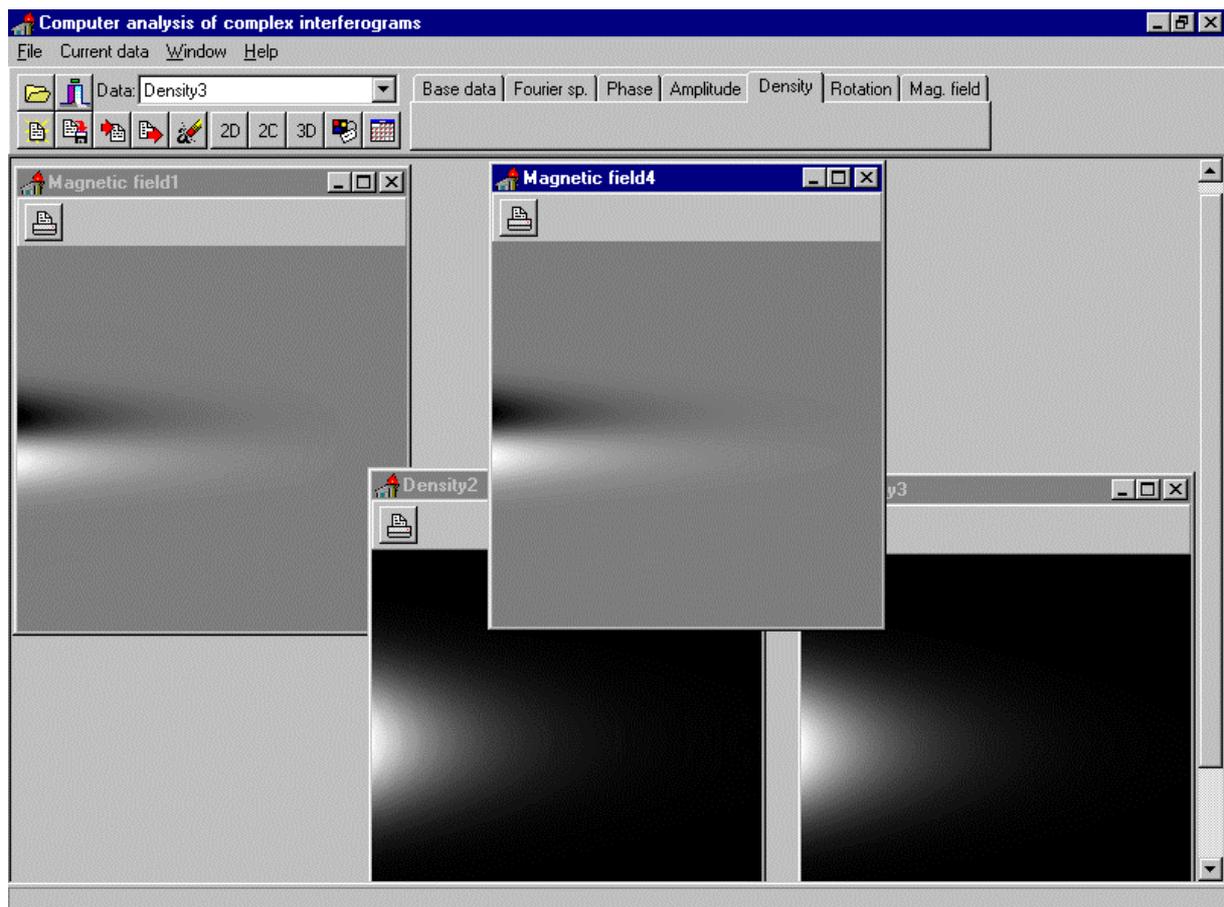
Fig. 3: The density and magnetic field profiles reconstructed from the simulated interferogram in the Fig. 2 (left) and the original data to be compared with (right).
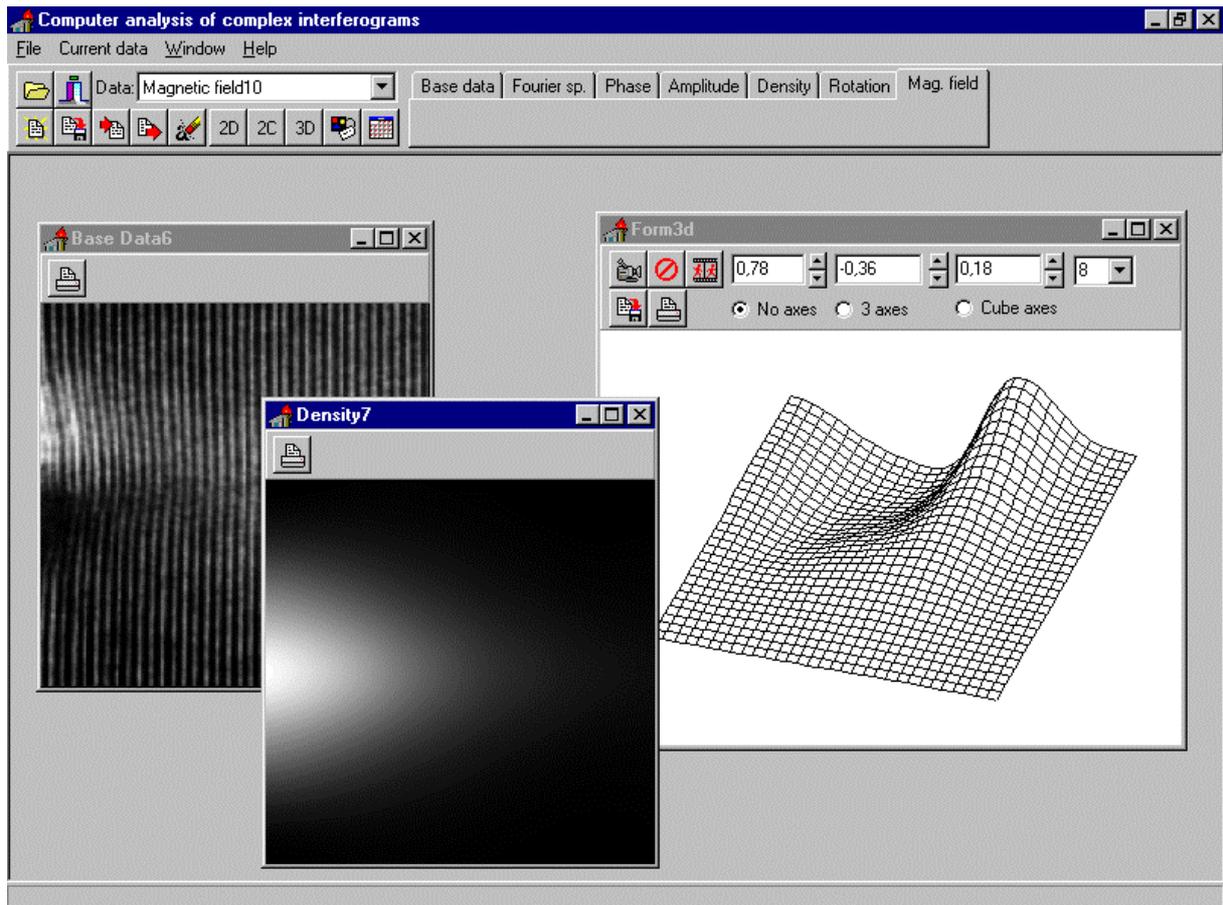
Fig. 4: The full screen shot of the running programme containing one experimentally obtained complex interferogram (left) with the reconstructed density profile (middle) and the magnetic field profiles (right).

More information about the program functionality and its availability can be found on our web pages **http://www-troja.fjfi.cvut.cz/~kalal**.

[1] M. Kálal: Czech J. Phys. **41**, 743-748 (1991)

[2] M. Kálal, K.A. Nugent and B. Luther-Davies: Appl. Opt. **26**, 1674-1679 (1987)

[3] M. Kálal, K.A. Nugent and B. Luther-Davies: J. Appl. Phys. **64**, 3845-3850 (1988)

[4] M. Takeda: Industrial Metrology **1**, 79-99 (1990)

[5] M. Kálal and K.A. Nugent: Appl. Opt. **27**, 1956-1959 (1988)

[6] R. Sixta: Diploma Work. KFE FJFI CVUT, Prague (1994)

[7] J. Repiský: Diploma Work. KFE FJFI CVUT, Prague (1996)