Tutorial 7

Structure Functions

The **Structure Functions** module opens a new window when the user clicks on the corresponding button of the left hand side panel of INA. This window is illustrated in Figure 1.
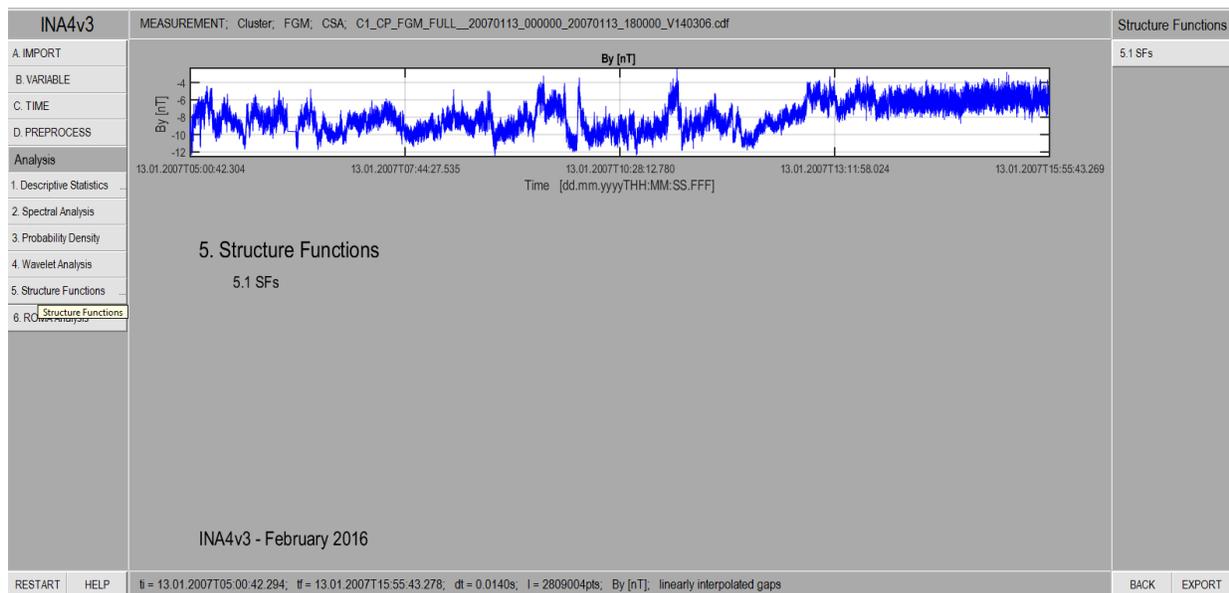

Figure 1. The main page of the Structure Functions (SFs) tool of INA. The plot shows the time series to be analyzed with this package. The SF analysis is started with the button at the right of the window.

The structure function (SF) of order q, for the time series $y(t)$ is defined as:

$$SF(q, \tau) = \langle |y(t + \tau) - y(t)|^q \rangle$$

, where τ is the scale and q gives the order of the SF analysis. In the conventional structure function analysis one searches for a power law variation of SF with the scale τ, i.e. $SF(q, \tau) \propto \tau^{\xi(q)}$. The case when the scaling exponent $\xi(q)$ is a linear function of the order q is of special interest as it can mean self-similarity.

The SFs button at the right hand side of the main Structure Functions window computes the structure functions for the same set of scales as those defined for the PDFs analysis (as described in Tutorial #4), and for the default set of orders q between 1 and 5. This default set of parameters can be modified by the user through changing the editable fields located in the right hand side control panel, as illustrated in figure 2. Using the set of scales and orders chosen by the user, the program also computes the exponent ξ as a function of q. The superposed linear fit of ξ as a function of q, is one of the main results of the conventional structure function analysis,

giving a direct visual representation of the linearity (mono-fractal) or non-linearity (multi-fractal) character of $\xi(q)$.

Figure 2 illustrates the SFs analysis module applied on the same time series discussed in the previous tutorials. We illustrate the Structure Functions for 5 orders q, between 1 and 5, computed on a scale interval ranging from tau = 2^ 0 to tau = 2^12.
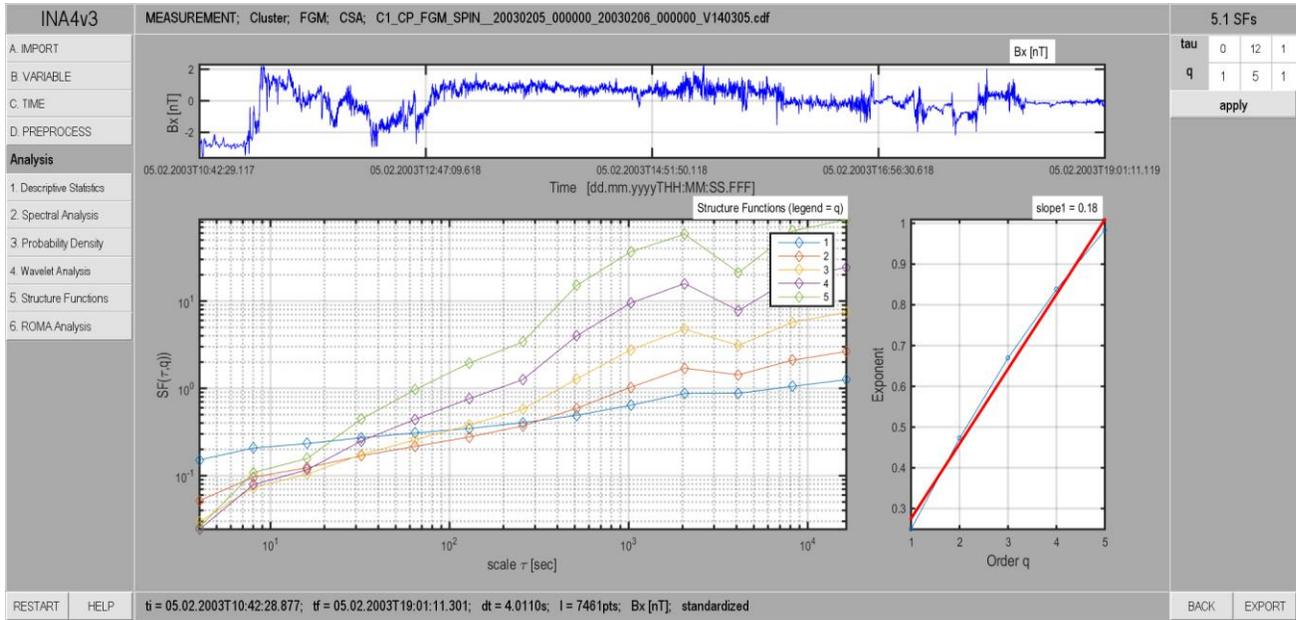

Figure 2. Illustration of the Structure Functions analysis class. The user controls the range of scales and the range of moment orders q.