SPECIFIC CHARACTER OF STUDYING TURBULENT FLOWS OF LIQUID METALS UNDER THE ACTION OF TRAVELING AND ROTATING MAGNETIC FIELDS

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The specific character of studying MHD-turbulence in liquid metal flows generated by the alternating magnetic fields is determined by the following factors: combined action of regular and pulsating parts of the applied magnetic filed on a metal flow; measurements of the filed pulsation and velocity under the conditions of intensive imposed electromagnetic pulsations. This problem is considered in our paper, which explores an isothermic turbulent flow of the gallium eutectic Ga-Zn-Sn alloy. Liquid metal fills a cylindrical channel having solid boundaries. The channel is placed into a cylindrical core of the inductor of the MHD-stirrer [1]. A peculiar feature of the examined process is that the clearance between the channel and the walls of the stirrer is rather small, which make it impossible to locate here some other sensing elements, for example, optical strain gauges. Therefore it appears that the only way of studying turbulence in the isothermal flow is to use conduction gauges. Each gauge consists of two pairs of electrodes placed around the constant magnet. The diameter of the gauge together with its case is 6mm. It measures the axial and azimuthal velocity components with the use of the NA128 amplifier (Texas Instruments) and NI 9227 24-bite adc. The discretization frequency is 5 kHz. The adc-device also receives the signals of the current loop connected to one of the phases of the power source and the analog output signals of the Gaussmeter Lakeshore 421; Hall's gauge of the Gaussmeter is located in the clearance between the channel and the stirrer walls.

Such an experimental scheme is commonly used in studies of this kind. The main problem of such investigations is that the gauge along with the useful velocity signals receives the noise pick-ups produced by the inductor of the MHD-stirrer. Therefore it is extremely difficult to separate the part of the signal where these noises have no effect. In this regard, our study has a twofold purpose: to define mean velocities and Fourier spectra and to analyze the wavelet-cross correlation of the velocity, magnetic field and current gauge signals [2]. For this purpose a complex Morlet wavelet transform is used. The analysis allows us to single out the frequency range where the signal correlation is high and thus to focus our attention on the results of the Fourier analysis of this frequency range.

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References

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