Geophysical Research Abstracts
Vol. 12, EGU2010-15554-2, 2010
EGU General Assembly 2010

Multivariate statistical data analysis methods for detecting baroclinic wave interactions in the thermally driven rotating annulus

Thomas von Larcher (1), Uwe Harlander (2), Kiril Alexandrov (2), and Yongtai Wang (2)
(1) FU Berlin, Institut für Mathematik, Germany, (2) BTU Cottbus, Dept. Aerodynamics and Fluid Mechanics, Germany

Experiments on baroclinic wave instabilities in a rotating cylindrical gap have been long performed, e.g., to unhide regular waves of different zonal wave number, to better understand the transition to the quasi-chaotic regime, and to reveal the underlying dynamical processes of complex wave flows.

We present the application of appropriate multivariate data analysis methods on time series data sets acquired by the use of non-intrusive measurement techniques of a quite different nature. While the high accurate Laser-Doppler-Velocimetry (LDV) is used for measurements of the radial velocity component at equidistant azimuthal positions, a high sensitive thermographic camera measures the surface temperature field.

The measurements are performed at particular parameter points, where our former studies show that kinds of complex wave patterns occur [1, 2]. Obviously, the temperature data set has much more information content as the velocity data set due to the particular measurement techniques.

Both sets of time series data are analyzed by using multivariate statistical techniques. While the LDV data sets are studied by applying the Multi-Channel Singular Spectrum Analysis ($M-SSA$), the temperature data sets are analyzed by applying the Empirical Orthogonal Functions (EOF).

Our goal is (a) to verify the results yielded with the analysis of the velocity data and (b) to compare the data analysis methods. Therefor, the temperature data are processed in a way to become comparable to the LDV data, i.e. reducing the size of the data set in such a manner that the temperature measurements would imaginary be performed at equidistant azimuthal positions only. This approach initially results in a great loss of information. But applying the $M-SSA$ to the reduced temperature data sets enable us to compare the methods.

[1] Th. von Larcher and C. Egbers, *Experiments on transitions of baroclinic waves in a differentially heated rotating annulus*, Nonlinear Processes in Geophysics, 2005, 12, 1033-1041, NPG Print: ISSN 1023-5809, NPG Online: ISSN 1607-7946

[2] U. Harlander, Th. von Larcher, Y. Wang and C. Egbers, *PIV- and LDV-measurements of baroclinic wave interactions in a thermally driven rotating annulus*, Experiments in Fluids, 2009, DOI: 10.1007/s00348-009-0792-5