RECONSTRUCTION OF THE DYNAMIC SYSTEM FROM EXPERIMENTAL DATA OF THE PRESSURE SIGNAL DURING DETONATION COMBUSTION IN A PULSEJET ENGINE

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Abstract: The reconstruction of ejector pulsejet engine processes during detonation combustion is presented. The reconstruction was carried out on the basis of experimental data of the pressure signal. The signal was obtained at the combustion chamber wall in the region of the detonation zone. The phase space was reconstructed and the dimensionality of the attractor and dynamical system was calculated. The calculated dimensionality of the dynamic system is equal to three. The constructed model reproduces the available experimental realizations of the system parameters with a given accuracy.

Keywords: ejector pulsejet engine; reconstruction of dynamic system; attractor

DOI: 10.30826/CE25180105 **EDN:** YWEYQU

Figure Captions

Figure 1 Ejector double-duct air-breathing pulsejet engine working on propane–butane with fuel–air heat exchanger: *1* — nozzle of fuel vapour supply; *2* and *3* — first and second mixers; *4* — combustion chamber; *5* — aerodynamic valve; *6* — air nozzles; *7* — resonator tube; *8* — fuel–air heat exchanger; and *9* — coil

Figure 2 Schematic diagram of the experimental setup. Dimensions are in millimeters

Figure 3 Visualization of the initial time series studied (signal duration — 1 s)

Figure 4 Phase trajectory of a time series: $N = 5000$, $v = 3$, and $\tau = 1$

Figure 5 Poincare cross-section

Figure 6 Double-logarithmic scaled correlation plot ($\varepsilon = [0.01 \cdots 0.18]$) for $m = [1 \cdots 1000]$ (*a*) and $m = 87$ (*b*)

Figure 7 Comparison of original y_1 (*a*), y_2 (*b*), and y_3 (*c*) (*1*) and reconstructed $y^{(1)}$ (*a*), $y^{(2)}$ (*b*), and $y^{(3)}$ (*c*) (*2*) signals

Figure 8 Comparison of original (*1*) and reconstructed (*2*) signals: intervals 1 and 2 — with the worst agreement of the results; and interval 3 — with the best agreement of the results

Figure 9 Comparison of original and reconstructed signals (position 3 in Fig. 8). On the right is the enlarged format of the row interval with the best match

Figure 10 Comparison of original and reconstructed signals (position 2 in Fig. 8). On the right is the enlarged format of the row interval with the worst match

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Received December 18, 2023
After revision October 18, 2024
Accepted October 22, 2024

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