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Reynolds number effect on jet control and its scaling DEWEI FAN, ZHI WU, Harbin Institute of Technology (Shenzhen), China, ARUN KUMAR PERUMAL, Indian Institute of Technology Kanpur, India, BERND R. NOACK, YU ZHOU, Harbin Institute of Technology (Shenzhen), China, HARBIN INSTITUTE OF TECHNOLOGY (SHENZHEN), CHINA TEAM, INDIAN INSTITUTE OF TECHNOLOGY KANPUR COLLABORATION — This work aims to investigate experimentally the effect of Reynolds number Re on the mixing effectiveness of a turbulent jet manipulated using a single unsteady radial minijet. A novel artificial intelligence (AI) control system has been developed to manipulate the turbulent jet. The Re examined is 8000-50000 based on the time-averaged jet exit velocity $\overline{U_j}$ and the nozzle exit diameter D. The control parameters include the mass flow rate ratio C_m of the minijet to main jet, the frequency ratio f_e/f_0 of the minijet excitation frequency f_e to the preferred-mode frequency f_0 of main jet, the duty cycle α, and the diameter ratio d/D of the minijet to the main jet. Jet mixing is quantified using K_e/K_0, where K is the decay rate of the jet centreline mean velocity, and subscripts e and 0 denote the manipulated and unforced jets, respectively. Empirical scaling analysis of the AI-obtained experimental data reveals that the relationship $K_e = g_1\ (C_m,\ f_e/f_0,\ \alpha,\ d/D,\ Re,\ K_0)$ may be reduced to $K_e/K_0 = g_2\ (\zeta)$, where $\zeta = \frac{\sqrt{MR}}{\alpha}\left(\frac{d}{D}\right)^n\frac{1}{Re}\left(\frac{f_e}{f_0}\right)^m$ (n and m are power indices) ,$\sqrt{MR} \equiv C_m\frac{D}{d}$ and g_2 is approximately a linear function. The scaling law is discussed, along with the physical meanings of the dimensionless parameters K_e/K_0, ζ, $\frac{\sqrt{MR}}{\alpha}\left(\frac{d}{D}\right)^n\frac{1}{Re}$ and $\left(\frac{f_e}{f_0}\right)^m$.

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