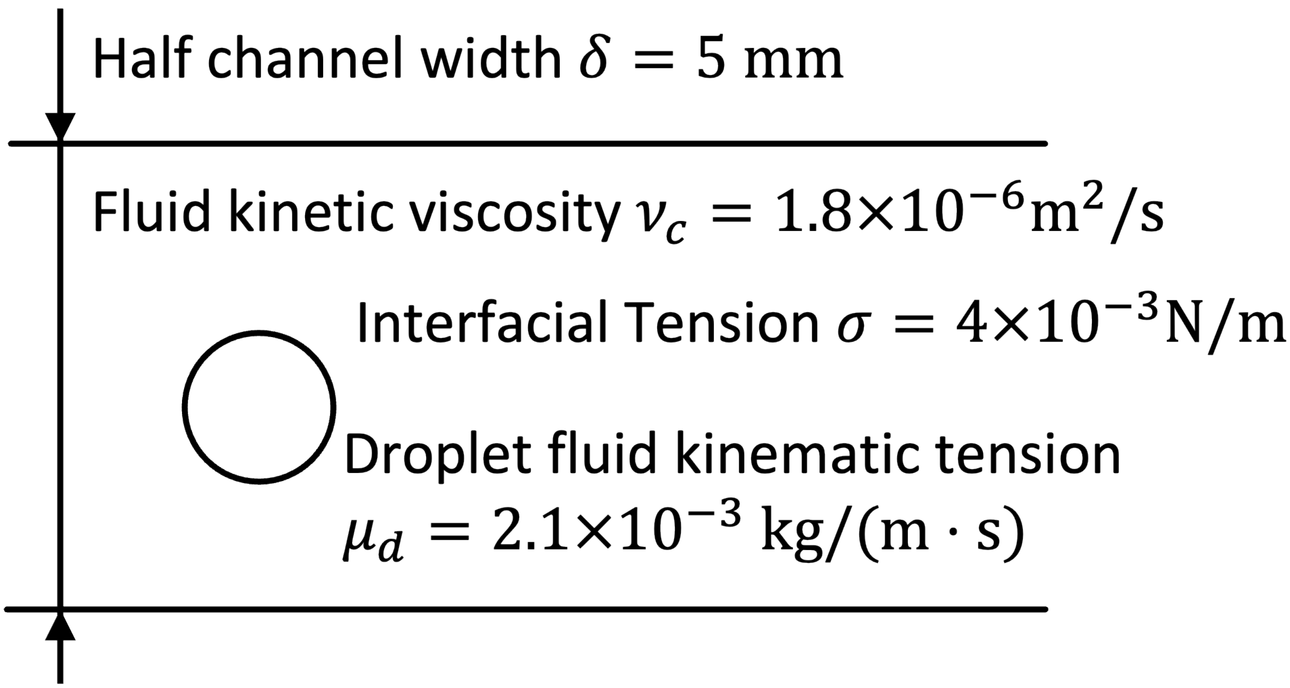
Description of Dimensionalization Process in the Program

Adopted Physical Parameters

To ensure consistency with the physical parameters reported in Reference [1], the program employs various material properties as illustrated in the accompanying figure.



Using the above values, the shear stress applied to the droplet is calculated as

$$\tau = \rho_c(\delta u_d)^2$$

where $\rho_c = 1000\mathrm{kg/m}^3$ is the mass density of the continumm phase fluid.

The implementation incorporates Taylor's frozen turbulence hypothesis to convert spatial sequences along the streamwise direction of the three-dimensional flow field into temporal sequences. The temporal scale δt is determined by the streamwise grid spacing Δx and a certain value $0.8U_{inf}$ is chosen as the local convection velocity:

$$\delta t = \Delta x/(0.8U_{inf})$$

Reynolds Number Conversion

The experimental configuration in Reference [1] was established for Taylor-Couette flow, where the Reynolds number is defined as:

$$Re = \frac{\omega_i r_i d}{\nu}$$

where ω_i represents the angular velocity of the inner cylinder, r_i the inner cylinder radius, d the gap width, and ν the kinematic viscosity.

For Taylor-Couette flow, the dimensionless torque parameter G characterizes the externally applied torque:

$$G = \frac{\tau}{2\pi L \rho \nu^2}$$

where τ denotes the applied torque, which equivalently corresponds to the total wall shear stress ($\tau = \tau_w$). Empirical analysis yields the relationship:

$$G = K Re^{1.58}$$

Through substitution of these expressions into the definition of friction Reynolds number $Re_\tau = \frac{u_\tau d}{\nu}$, we establish the conversion relationship between the experimental Reynolds number Re and the friction Reynolds number Re_τ as reported in Reference [1].

[1] Yi L, Toschi F, Sun C. Global and local statistics in turbulent emulsions. Journal of Fluid Mechanics. 2021;912:A13. doi:10.1017/jfm.2020.1118