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Chaotic dynamics of red blood cells in oscillating shear flow PROSENJIT BAGCHI, DANIEL CORDASCO, Rutgers University — A 3D computational study of deformable red blood cells in dilute suspension and subject to sinusoidally oscillating shear flow is considered. It is observed that the cell exhibits either a periodic motion or a chaotic motion. In the periodic motion, the cell reverses its orientation either about the flow direction or about the flow gradient, depending on the initial conditions. In certain parameter range, the initial conditions are forgotten and the cells become entrained in the same sequence of horizontal reversals. The chaotic dynamics is characterized by a nonperiodic sequence of horizontal and vertical reversals, and swings. The study provides the first conclusive evidence of the chaotic dynamics of fully deformable cells in oscillating flow using a deterministic numerical model without the introduction of any stochastic noise. An analysis of the chaotic dynamics shows that chaos is only possible in certain frequency bands when the cell membrane can rotate by a certain amount allowing the cells to swing near the maximum shear rate. We make a novel observation that the occurrence of the vertical or horizontal reversal depends only on whether a critical angle, that is independent of the flow frequency, is exceeded at the instant of flow reversal.

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