In natural environments, bacteria seldom traverse through simple Newtonian fluids. Instead, they typically navigate through complex and anisotropic surroundings, such as the highly dynamic viscoelastic and anisotropic mucus gel lining our organs, the birefringent domains of extracellular matrix and bacterial cellulose-based materials, and biofilms growing on solid surfaces where swimming is inefficient. In these settings, bacterial movement is primarily dictated by hydrodynamic interactions with the surrounding anisotropic fluid and confinement, resulting in bacteria aligning with the direction of decreased viscosity rather than the well-documented Run-and-Tumble random walk. Our recent findings indicate that bacteria may exploit the anisotropy of the fluids to enhance their motility. The peritrichous *Bacillus subtilis* adopt a polar configuration to navigate the biocompatible liquid crystal DSCG using two opposing bundles working against each other in a flagellar Tug-of-Oars. The numbers of flagella in each bundle are dynamic, and their rearrangement is contingent on the buckling of individual flagella during motor reversal. The Frank constant for DSCG significantly shifts the critical compression for the Euler buckling of the filaments, preventing flagellar rearrangements at high liquid crystal concentrations and hindering almost all swimming reversals. However, in this regime, we identified what we think is a new mechanism for bacterial exploration of anisotropic media, where bacteria flip swimming directions by dynamically turning on and off individual entire bundles on opposite sides of the cell body. Our results raise questions on the signal transduction at the level of groups of flagella motors located closely on the cell surface.