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Inferring ice-core physical properties nondestructively from elastic P- and S-wave velocities

Content

We propose an optimization problem for inferring either the bulk elastic parameters or orientation fabric of ice-core samples given ultrasonic (elastic) P- and S-wave phase velocities measured at different sample orientations. Specifically, we consider recently-published ice-core measurements from the shear margin of Priestly glacier, Antarctica, and show that inferred bulk (effective) elastic parameters are close to, but not equal to, the elastic parameters previously measured for single ice crystals. Next, by expanding the c-axis distribution function in terms of spherical harmonics series, we show how ice-core fabrics might generally be inferred non-destructively without assuming the type of fabric pattern a-priori. Finally, we discuss the well-posedness of the inverse problem, relevant for guiding future laboratory experiments where the sought-after fabric is truly unknown.

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