For Describing Uncertainty, Ellipsoids Are Better than Generic Polyhedra and Probably Better than Boxes: A Remark

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For a single quantity, the set of all possible values is usually an interval. An interval is easy to represent in a computer: e.g., we can store its two endpoints. For several quantities, the set of possible values may have an arbitrary shape. An exact description of this shape requires infinitely many parameters, so in a computer, we have to use a finite-parametric approximation family of sets. One of the widely used methods for selecting such a family is to pick a symmetric convex set and to use its images under all linear transformations. If we pick a unit ball, we end up with ellipsoids; if we pick a unit cube, we end up with boxes and parallelepipeds; we can also pick a polyhedron. In this paper, we show that ellipsoids lead to better approximations of actual sets than generic polyhedra; we also show that, under a reasonable conjecture, ellipsoids are better approximators than boxes.