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## Multicell parameterisation for sensitivity analysis and uncertainty quantification of elliptical accelerator cavities

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Elliptical cavity geometries are typically parameterised using a canonical set of variables that define the shape of the cavity half-cells. In multicell cavity optimisation, the mid-cells are modelled with identical dimensions, while the end-cells are optimised to ensure good field flatness. However, manufacturing tolerances can introduce slight variations between individual half-cells, as cavities are produced with separate dumb-bells, which are thereafter welded together. To address these variations, a multicell parameterisation is proposed, where each half-cell is defined by its own set of variables. This parameterisation method offers a more accurate representation of real-world cavity geometries and facilitates a detailed analysis of the impact of geometric uncertainties on cavity performance. A sensitivity analysis is presented to quantify the influence of each independent geometric variable on key performance metrics, providing valuable insights for optimising both cavity design and manufacturing processes.

### Footnotes

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