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Expecting the unexpected: quantifying the persistence of unexpected hypersurfaces

Let X be a reduced subscheme in $\mathbb{P}^n$. We say that X admits an unexpected hypersurface of degree d and multiplicity m if the imposition of having multiplicity m at a general point P fails to impose the expected number of conditions on the linear system of hypersurfaces of degree d containing X. We introduce new methods for studying unexpectedness, such as the use of generic initial ideals and partial elimination ideals to clarify when it can and when it cannot occur. We formulate a new way of quantifying unexpectedness (our AV sequence), which allows us detect the extent to which unexpectedness persists as increases but remains constant. We also study how knowledge of the Hilbert function, together with certain geometric assumptions, can provide information about unexpected hypersurfaces.