Linear-fractional Galton-Watson process with a general type space

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We study a discrete time branching random walk over a general state space E. The corresponding measure-valued branching process is defined by a triplet (K, γ, m) consisting of a sub-stochastic kernel $K(x, A)$ for the location of the first offspring, probability measure $\gamma(A)$ for the locations of the offspring beyond the first one, and a number $m \in (0, \infty)$. This multi-type Galton-Watson process has an embedded single-type Crump-Mode-Jagers process whose tree contour is described by an alternating random walk.

We illustrate our findings in terms of a simple example with $E = [0, \infty)$, $K(x, A) = e^{-x}\mathrm{P}(x + Y_\lambda \in A)$, where Y_λ is an exponential with parameter λ, and $\gamma(A) = \mathrm{P}(Y_\mu \in A)$, where Y_μ is an exponential with parameter μ.

This is joint work with Alexey Lindo.