Estimating the division rate and kernel in growing and/or dividing populations

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Growing and dividing populations may be described either by stochastic branching processes or by integro-differential equations, both related by the fact that the integro-differential equation may be seen as the Kolmogorov equation of the branching process. Denoting $u(t,x)$ the concentration of individuals of size x at time t, a typical growth-fragmentation equation may be written as

$$\frac{\partial}{\partial t}u(t,x) + \frac{\partial}{\partial t}(g(x)u(t,x)) + B(x)u(t,x) = \int_0^1 B(\frac{x}{z})u(t,\frac{x}{z})\frac{dk_0(z)}{z},$$

where $g(x)$ is the growth rate, $B(x)$ the division rate, and k_0 is called the (self-similar) fragmentation kernel, which characterizes the probability for a dividing particle of size $\frac{x}{z}$ to give rise to an offspring of size x. During the last decade, using the asymptotic behaviour of this equation or of the related stochastic process to estimate the division rate ($B(x)$ in the equation) of a population has led to many interesting questions and results, in mathematics as well as in biology. In this talk, I will review some of them, and focus on the question of estimating the fragmentation kernel k_0, which revealed a much more ill-posed problem than estimating the division rate $B(x)$.
This is joint work with Magali Tournus, Miguel Escobedo and Wei-Feng Xue.