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Discrete Coagulation-Fragmentation Systems

In many situations in nature and industrial processes, clusters of particles can combine into larger clusters or fragment into smaller clusters. The evolution of these clusters can be described by differential equations known as coagulation-fragmentation equations. In the discrete size case it is assumed that the mass of each cluster is a natural number and a cluster of mass n consists of n identical units. The main part of the talk will concentrate on the case of pure discrete fragmentation.

The fragmentation system will be written as an abstract Cauchy problem (ACP) in a weighted ℓ^1 space, with weight $(w_n)_{n=1}^{\infty}$. Previous investigations, [1], [2], have considered the space where the weight is of the form $w_n = n^p$ for some $p \geq 1$. When $p = 1$ the norm reflects the total mass in the system of clusters and so this is the most physically relevant space to work in. However, we have also found it useful to examine the system in weighted ℓ^1 spaces with more general weights. In particular, for any fragmentation rates, we can always find a weighted ℓ^1 space such that there exists an analytic semigroup related to the fragmentation ACP. This result is obtained using perturbation results, which cannot be applied when the weight is of the form $w_n = n$. Using this analytic semigroup, and a Sobolev tower construction, we examine the existence and uniqueness of solutions to the fragmentation system.

The full coagulation-fragmentation system, where the coagulation coefficients may be time-dependent, may also be briefly examined.

References

[1] J. Banasiak, *Global classical solutions of coagulation-fragmentation equations with unbounded coagulation rates*, Global classical solutions of coagulation-fragmentation equations with unbounded coagulation rates **13** (2012), 91–105.

[2] A.C. MxBride, A.L. Smith, and W. Lamb, *Strongly differentiable solutions of the discrete coagulation-fragmentation equation*, Phys. D **239** (2010), no. 15, 1436–1445.