Averaging Lemmas with Random Discrete Velocities and Rosseland Approximation

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The averaging lemmas are very popular and efficient tools when it comes to establishing scale changes in physical models by passing to the limit. Indeed, they make it possible to establish properties of regularity from which we can deduce compactness. A well-known result is that, when working at discrete velocities, then the regularity property established by the averaging lemmas becomes false. However, as proved by Mischler, when discrete velocities come from a discretization of space, the averaging lemmas can be found asymptotically when the step of the grid converges to 0. In this work, we complete the Mischler result by quantifying the regularity defect at N fixed. On the other hand, we establish that when discrete velocities are randomly chosen, we can then establish stochastic averaging lemmas. We apply these stochastic averaging lemma results to the Rosseland approximation framework, an equation associated with the radiative transfer domain, and establish the diffusive limit in the context of random discrete velocities.

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