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Model of spreading depression and existence of travelling front

Spreading depression is a transient depolarization of neurons that spreads slowly through a part of the brain during stroke, epilepsy or migraine with aura. They have been observed and studied in most animal species for more than 50 years, but their existence in the human brain is still discussed. Mathematical models of spreading depressions have been established; they are linked to a reaction-diffusion mechanism. After some numerical experiments, we have made the following hypothesis: The mechanisms that trigger spreading depressions are the same in the human brain as in the rodent brain, but the morphology of the human brain could explain the non-observation of these waves.

Hence I have studied the following equation:

$$\partial_t u - \Delta u = \lambda u(u - \theta)(1 - u)1_{|z| < R} - \alpha u 1_{|z| \geq R}$$

where $(x, z) \in \mathbb{R}^N$ is the space variable.

I have proved that if R is small enough, there is no travelling front solution of these equation. And if R is large enough, there exists a travelling front in the x -direction. This result is obtained by studying the energy of a solution with special initial conditions in several travelling referentials.