Reaction-diffusion systems with spatially distributed relays

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We consider reaction-diffusion systems involving a hysteretic discontinuity (non-ideal relay) which is defined at each spatial point. These problems describe chemical reactions and biological processes in which diffusive and nondiffusive substances interact according to hysteresis law.

Hysteresis may switch at different spatial points at different time moments, dividing the spatial domain into subdomains where hysteresis has the same state and thus defining spatial topology of hysteresis. The boundaries between the subdomains are free boundaries whose motion depends both on the reaction-diffusion equation and hysteresis. The interplay of those two leads to formation of spatio-temporal patterns.

We formulate a theorem that states that the problem has a unique solution as long as this solution preserves the spatial topology of hysteresis, while the change of topology may occur only via a spatial nontransversality of the solution. In the end, we will discuss the behavior of the solution after such a nontransversality occurs.

This is a joint work with Sergey Tikhomirov.