

Online Seminar on Chemotaxis

Date: 22nd of March 2022 10:00 – 11:00 in “Central EU” hour
(which is 17:00 – 18:00 in “Beijing” hour and 18:00 – 19:00 in “Seoul–Tokyo” hour)

Speaker: Dariusz Wrzosek (University of Warsaw)

Title: Direct/indirect taxis and pattern formation in predator-prey models

Abstract: Please look at the next page.

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Direct/indirect taxis and pattern formation in predator-prey models.

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In the context of diffusive predator-prey models we adhere to the following terminology :

- direct prey-taxis is a directed movement of predator toward the gradient of prey density,
- **indirect prey-taxis** is a directed movement of predator toward the density gradient of a chemical released by prey,
- direct repulsive predator taxis is the directed movement of prey in the opposite direction to the gradient of predator density.
- **indirect repulsive predator taxis** is a directed movement of prey in the opposite direction to the density gradient of a chemical released by predator.

The indirect taxis is related to a chemical signaling which is an ubiquitous in nature mechanism used as mean of inter and intraspecific communication. The ability to detect specific chemicals (eg. pheromons, kairomons) enables prey to detect predators and trigger anti-predator responses while in the case of predators it helps to direct prey search. We try to answer two questions related to classical prey-predators models extended to grasp taxis mechanisms:

- What are the basic differences in properties of solutions to direct and indirect taxis models when a kinetic O.D.E. part remains the same?
- Can the classical diffusive predator prey model enriched by the taxis terms describe the tendency to spatiotemporal separation between prey and predators, by either avoiding areas inhabited by potential predators or using those areas at different times than the predators?
- Can the coexistence steady state stemming from O.D.E. be destabilized by indirect repulsive chemotaxis leading to the pattern formation?

We shall provide a survey of recent results related to direct/indirect prey predator models as well as pursuit-evasion models. Next the results contained in

- (1) Purnendu Mishra, D.W., *Repulsive chemotaxis and predator evasion in predator prey models with diffusion and prey-taxis*, M3AS, Vol. 32 (2022)
- (2) Purnendu Mishra, D.W., *Indirect taxis drives spatio-temporal patterns in an extended Schoener's intraguild predator-prey model*, Appl. Math. Letters, Vol. 125, (2022)

will be described in more details. In particular, in the first paper the classical Rosenzweig-MacArthur predator-prey model in diffusive version was generalized in two directions. First, when the indirect repulsive predator taxis is taken into account then for any space dimension $n \geq 1$ there exist global-in time-classical bounded solutions. In the second case we consider in addition the prey taxis including such a model in the class of pursuit-evasion models and the existence of classical global solutions is then proved only for $n = 1$, and numerical solutions for $n = 2$ indicate the formation of singular solutions in finite time.