Swimming phenomenon and controllability.

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Course description: The subject of our interest in this course is the swimming phenomenon from the viewpoint of controllability theory for partial differential equations. We intend to address this problem by investigating the controllability properties of an abstract object (a ``swimmer'') which applies fishlike or rowing motion to propel itself in a fluid (as opposed to bodies that are drifting or being pushed/pulled in a fluid by external forces). This object can be viewed as a simplified model of a swimming living organism or an artificial mechanical device.

We will introduce models describing the self-propelled motion of small ``swimmers'' in the 2- and 3-D incompressible fluids governed by the non-stationary Stokes equation, typically associated with the low Reynolds numbers and will investigate their wellposedness. It is assumed that the swimmer's body consists of finitely many subsequently connected parts, identified with the fluid they occupy, and linked by rotational and elastic forces. Models like this are of interest in biological and engineering applications dealing with the study and design of propulsion systems in fluids.

We will discuss the principal question on how the geometric shape of a swimmer affects the forces acting upon it when it is placed inside the fluid. This phenomenon is directly responsible for the fact of principal possibility of swimming (i.e., self-propulsion). Respectively, the answer to this question will provides us with the means to further discuss both local and global controllability of respective 2- and 3-D swimming models.

This course is based on the recent research monograph of the instructor and subsequent publications. We will also discuss other available approaches to modeling of swimming phenomenon.