Lecture 3 – Fumin Zhang

Tracking: virtual particles, boundary tracking, cooperative tracking, underwater applications

Path following or curve tracking behaviors serve as a basic building block for mobile robotics. In this lecture we will introduce a general method for curve tracking that captures and extends most popular methods in the literature. This method is based on modeling the geometric relationships between a real particle and its projection on a curve. In a planar setting, the curve will be described by natural Frenet equation, the interaction is modeled as relative displacement on the Lie group SE(2) and the desired state of tracking can be viewed as a relative equilibrium that can be asymptotically stabilized by a controller based on a Lyapunov function. This procedure for tracking control is then generalized to the three dimensional setting where curves on a smooth surface can be followed. The natural Frenet frames associated to the rigid motion group SE(3) play important roles in modeling the interaction between the real particle and the surface. The resulting curve tracking control laws have enabled cooperative sensing applications in real life maritime settings with impressively robust performance. Some insights on the robustness of the tracking control will be discussed.