Abstract: Large fluctuations play a fundamental role in a wide range of important processes -- from earthquakes to nucleation at phase transitions, also for mutations in DNA sequences, for thermal instability of quantum dot and for magnetic reversal in nano-magnets. Such large fluctuations can be considered in the framework of the concept of optimal paths – deterministic patterns of stochastic motion. The main advantage of this concept is that it can be applied to non-equilibrium multi-dimensional systems and, thus, the concept enables the investigation of a wide range of problems that are important in engineering, physics and biology. I will consider the application of this concept for understanding and controlling large fluctuations in systems with chaotic attractors. Properties of two different types of chaotic attractors: quasi-hyperbolic and non-hyperbolic, will be briefly discussed and the problem of noise-induced escape from these attractors will be analysed. Then molecular dynamics modelling of transport of an ion via a protein will be considered. Existing approaches for describing ion motion will be briefly discussed and ion’s transport in KcsA Potassium Channel will be analysed.