Optimization problems with oscillating controls

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We will discuss optimal control problems related to infinitesimally optimal path following. This leads to nilpotent approximations and optimal problems on nilpotent Lie groups. Based on a common work with J.-P. Gauthier and V. Zakalyukin, we will show how harmonic oscillatory controls solve the problem for 1-step non-holonomic systems. We will give an explicit formula for a measure of complexity of the problem, called the entropy. For more general systems one should solve certain open optimization problems involving Lie polynomials.