On L^1–minimization in optimal control and its relation to bang–bang control

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Abstract: There exists an extensive literature on the minimum principle for optimal control problems with non–smooth data. Nonetheless, the literature on practical examples and numerical methods in this field is rather scarce. As a model control problem we discuss the free flying robot where the L^1–norm of the control is minimized. A numerical solution of this problem has been attempted in the literature which, however, fails to satisfy the necessary conditions of the minimum principle. We present a detailed discussion of the minimum principle and investigate in particular those sections of the control that correspond to non–smooth parts. Two numerical methods are proposed to handle the non–smoothness: (1) a regularization technique; (2) a transformation to a smooth control problem with a higher–dimensional control. The second approach leads to an optimal bang–bang control with a high number of bang–bang arcs.