

**Time-optimal decompositions in  $SU(2)$**  This work is motivated by applications to quantum mechanics and quantum computing. In quantum computing, an algorithm is an element of  $SU(N)$ . An algorithm is realized using quantum controls, which are elements of some fixed 1-parametric subgroups. It is well-known that given a set of generators of the Lie algebra  $\mathfrak{su}(N)$ , the corresponding 1-parametric subgroups generate the group  $SU(N)$ . It is natural to ask how to find decompositions with the given set of generators that minimize the total time. We solve this problem for  $SU(2)$ . The answer turns out to be non-trivial even in this simplest case.