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Summary: The source localization problem has been studied by many researchers and applied to a wide range of areas including Global Positioning System (GPS) localization. Although there have been studies examining closed form solutions for cases with not so large noise, only the existence of local solution in $L^2$ minimization settings is known. In this paper, $L^1$ minimization with three measurements is studied, and nonuniqueness examples for the minimization are provided. Further, the uniqueness of the solution in certain conditions is stated and proven. The proof is based on the analysis for the extreme points of the objective function. The singular points are the three source points and the three measurement circles. The critical points are the Fermat point and some points located inside of one measurement circle and outside two other circles. The numbers of the latter critical points are infinite for the equilateral measurement triangle and one for nonequilateral measurement triangle. The analysis for these critical points is also provided. Finally, a few numerical implementations are provided to clarify the uniqueness and nonuniqueness of the problem.

MSC:
90Cxx Mathematical programming
94Axx Communication, information
51Mxx Real and complex geometry

Keywords:
source localization; GPS; Fermat point; measurement circle

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References:

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