

# Inverse problems in diffusion

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**Abstract.** The problem of estimating the diffusive characteristics of a fluid and a porous medium arises in several applications, for instance, the filtration of underground water in mining and the prediction of flow from wells in the recovery of crude oil. Such modeling problems constitute mathematical "inverse problems" because they involve the estimation of the yet unknown equations governing the diffusion. By way of contrast, mathematical "direct problems" consist of finding solutions to known equations. In other words, inverse problems build models, whereas direct problems test models.

Inverse problems of several types also have other applications and form the subject of intensive research. Reflecting the difficulty of the theory, expository accounts of inverse problems involve mathematics beyond calculus. Because of the practical and theoretical relevance of the subject, however, it appears appropriate to introduce at least the concept of inverse problems to students at the level of calculus. Thus the mathematical inverse problems that will be proposed in this project require knowledge only of partial derivatives (MATH1932), while the physics require knowledge only of the divergence theorem (MATH2420).