
Optimization Problems for Port-of-Entry Detection Systems

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Abstract. The problem of container inspection at ports-of-entry is formulated in several different ways as an optimization problem. Data generated from different analytical methods, x-ray detectors, gamma-ray detectors and other sensors used for the detection of chemical, biological, radiological, nuclear, explosive, and other illicit agents are often relied upon to make critical decisions with regard to the nature of containers presented for possible inspection and the appropriate response mechanism. Several important questions related to the utilization and coordination of multiple sensors for container inspection are discussed. New and efficient algorithms for finding the best inspection strategy, including the optimal sequencing of sensors and optimal assignment of thresholds for interpreting sensor readings, are described. Models and algorithms that can be used by decision makers, allowing them to minimize expected cost of inspection, minimize inspection errors (both false positives and false negatives), and/or maximize the throughput of containers, are outlined.

17.1 Introduction

Finding ways to intercept illicit materials, in particular weapons, destined for the U.S. via the maritime transportation system is an exceedingly difficult task. Practical complications of inspection approaches involve the negative economic impacts of surveillance activities, errors and inconsistencies in available data on shipping and import terminal facilities, and the tradeoffs between costs and potential risks, among others. Until recently, even with increased budget and emphasis, and rapid development of modern technology, only a very small percentage of ships entering U.S. ports have had their cargo inspected. Thus there is a great need to improve the efficiency of the current inspection processes. There has been a series of attempts to develop algorithms that will help us to inspect for and intercept chemical, biological, radiological, nuclear, and explosive agents, as well as other illicit materials. Such algorithms need to be developed with the constraint that seaports are critical gateways for the movement of international commerce. More than 95 percent of our non-North American foreign trade arrives by ship. With “just-in-time” deliveries of goods, the expeditious flow of commerce through these ports is essential. Slowing the flow long enough to

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