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DISCUSSION OF "NETWORK ROUTING IN A DYNAMIC ENVIRONMENT"[1]

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1. Introduction. An earlier version of Professor Singpurwalla's paper (which we refer to as "Singpurwalla") has served as the springboard to our own investigation of the issue of deployments of Improvised Explosive Devices, or other obstacles with a large cost to overcome, which may be placed stochastically, or by an adversarial agent, or both.

Rather than a decision-theoretic treatment, we consider a method based in part on social network analytical methods, namely, that the deployment pattern of IEDs induces a subgraph on a full road network, and that the deployment on any given road is unknown to anyone traversing the graph until arriving there, though there may be prior information on the likelihood of a deployment.

The full treatment, as acknowledged in Singpurwalla, is illustrated by Thomas and Fienberg (2011); here, we give a brief overview of our method and how it compares with Singpurwalla's approach.

2. Canadian traveler problems and network transition times. Many analyses of social networks assume that the shortest path between two individuals governs properties of their inter-relationship, and this has led to many metrics constructed using geodesic distance to approximate the importance of an individual [Freeman (1979)]. If the streets were empty of traffic, a driver on the roads will think the same way, taking the route that minimizes travel time. This is not necessarily the case when the state of the roads is uncertain, such as with traffic or construction, but is nicely encapsulated in the "Canadian Traveler Problem" formulation [Andreatta and Romeo (1988); Bar-Noy and Schieber (1991); Papadimitriou and Yannakakis (1991)]: a road may be impassable because, with some probability, there is an obstacle that cannot be traversed without waiting (in the eponymous case, a heavy snow fall). If the probabilities are known in advance, but the actual states of the roads are not known until reached, then an optimal route can be calculated either through exact solution or simulation, by solving for the distribution of travel times along any particular route, simulating the blockages given their propensities.

Given that all roads have some probability of a blockage, IED deployment or otherwise, we can evaluate a road's importance for travel by comparing the average travel time if the road is active to that when the road is blocked, given a source

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