UFRN
UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

Exame de Proficiência

2022.2

Inglês **Engenharia**

Instruções

1	Confira se os dados contidos na parte inferior desta capa estão corretos e, em seguida, assine no espaço reservado para isso. Se, em qualquer outro local deste Caderno, você assinar, rubricar, escrever mensagem, etc., será excluído do Exame.
2	Este Caderno contém 5 questões discursivas referentes à Prova da Língua Estrangeira escolhida pelo candidato. Não destaque nenhuma folha.
3	As respostas às questões deverão ser redigidas **em PORTUGUÊS**.
4	Se o Caderno estiver incompleto ou contiver imperfeição gráfica que impeça a leitura, solicite imediatamente ao Fiscal que o substitua.
5	Será avaliado apenas o que estiver escrito no espaço reservado para cada resposta, razão por que os rascunhos não serão considerados.
6	Escreva de modo legível, pois dúvida gerada por grafia, sinal ou rasura implicará redução de pontos.
7	**Só será permitido o uso de dicionário INGLÊS/INGLÊS.**
8	A Comperve recomenda o uso de caneta esferográfica, confeccionada em material transparente, de tinta preta. Em nenhuma hipótese se avaliará resposta escrita com grafite.
9	Utilize para rascunhos o verso de cada página deste Caderno.
10	Você dispõe de, no máximo, três horas, para responder as 5 questões que constituem a Prova.
11	Antes de retirar-se definitivamente da sala, devolva ao Fiscal este Caderno.

Assinatura do Candidato: ____

COMPERVE
UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

As questões de 01 a 05, cujas respostas deverão ser redigidas EM PORTUGUÊS, referem-se ao texto abaixo.

A NETWORK OBSERVABILITY FRAMEWORK FOR SENSOR PLACEMENT IN FLOOD CONTROL NETWORKS TO IMPROVE FLOOD SITUATIONAL AWARENESS AND RISK MANAGEMENT

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Introduction

A significant proportion of losses caused by natural disasters are related to flood events in urban regions. Thus, floods are a substantial threat to urban areas because they endanger the functionality of urban infrastructure systems and pose significant risks to the social well-being of the community. Climate change also drives the increasing risk of devastating floods. Besides, rapid urbanization introduces changes to cities' physical and social schemes such as infrastructure development and population density across the city. The large tracts of impervious surfaces exacerbate the flood risk either by growing the number of assets and human at risk or by increasing the intensity of a flood such as peak and volume of runoff following an extreme rainfall. The response of a community to a disaster is significantly hinged on the performance of infrastructure systems that are primarily designed and developed to enhance the quality of life in the community. The interaction between infrastructure and disasters is not limited to the damages that disasters can potentially impose on infrastructure. Disaster-induced damages to the infrastructure also affect the ability of the community to respond to the hazard and bounce back to the targeted recovery level in the aftermath of a disaster.

One of the crucial steps for assuring the proper functionality of infrastructure during an extreme condition is to proactively monitor the performance of the system, based on which we can diagnose the failures in the system, then make decisions to restore the functionality of the damaged component or supply alternative resources for compromised services, as well as reduce the impacts of failure by informing residents in the affected region to make proper decisions regarding their safety and well-being. To plan for coping with the induced failures, it is critical to devise tools to sufficiently monitor the failure propagation in the system. Critical infrastructure systems, such as transportation, water/gas distribution systems, and power grids can be modeled as networks. The ability to monitoring their states is defined as observability. In a network, observability is characterized by the minimum number of sensors that are needed to monitoring the whole network or a certain part of the network. In infrastructure observability, the objective is monitoring the functionality of sub-components of a complex network by gathering data from sensors that are properly placed on a subset of network components. The problem is often represented as finding the proper configuration of sensors in a way that the state of functionality of the network or a subset of the network can be monitored using the data collected from the sensors.

The flood control system can be represented as a network in which different components are connected using rivers, bayous, and channels. A flood control network plays a critical role in flood risk management by enabling proper stormwater discharge and preventing inundation in urban regions. The state of a flood control network is often monitored by a set of flood gauges (i.e., sensors) that collect the data measuring parameters such as water level and rainfall amount. These data are used by authorities for various purposes such as identifying flooded areas and improving citizens' situational awareness, as well as implementing models that can predict the flooded areas in near real-time. So far, the placement of these gauges is often done based on expert judgment and does not take into consideration how the data collected from the sensor network can provide maximum information to monitor the flooding status. In order to have the required information for better management of flood control networks, the design of the configuration and location of sensors can benefit from the network observability theory, which enables targeted monitoring of critical regions by the minimum number of flood gauges that can provide sufficient information required to infer the state of components in those regions. To address this important gap, this study proposes a network observability framework for monitoring flood control networks to enhance risk management.

Concluding Remarks

In this study, we proposed a framework to identify the best sensor set for targeted observability of flood control networks for enhanced flood monitoring and food situational awareness. The framework consists of three main components including the identification of critical nodes for observability, determination of the sensor sets that enable targeted observability, and identification of the best sensor set considering the importance of the channels based on their discharge capacity and their contribution to system-level vulnerability of inundation propagation. We tested the framework in the context of Harris County, Texas and showed that the framework can determine additional sensor sets for targeted observability. The results show the necessity of improving the flood monitoring infrastructure and enhanced flood warning system to support critical tasks such as evacuation and emergency response during a devastating flood. In addition, the framework enables placing sensors more efficiently, preventing overuse of sensors in specific areas, and consequently, developing sensor network in areas of higher vulnerability and criticality.

The findings of this study can be used to inform future installment of sensors for better monitoring the rainfall level and water level during heavy rainfalls in flood prone areas such as Harris County. In addition to better network observability, the information gathered by the strategically distributed sensors can facilitate better flood prediction modeling. Furthermore, the enhanced network observability enables the residents to better understand flood risk in their neighborhood to make proper actions in a timely manner to protect their lives and assets. Finally, the framework enables identifying optimal sensor network configuration when the criticality is defined in a different way. This flexibility increases the usefulness of the framework such that it can be used for a gradual improvement of the sensor network by extending the concept of criticality and adding the number of critical locations to be observed by the system. For example, the authorities can initially plan to develop the sensor network to monitor the 100-year floodplain and then gradually place more sensors such that the sensor network enables observing 500-year floodplain. The concept of criticality can be redefined considering the preference of decision makers. For example, we considered loss of access to healthcare as a criterion for determining criticality. However, the criticality can be defined using other parameters such as social vulnerability of regions, access to shelter, or ease of evacuation during a flood. Moreover, one direction for future studies can be using various techniques for performing simulation to quantify the consequences of implementing each sensor configuration. It can help decision makers see the influence of the how the data is acquired and decisions are made upon the information on the actual losses and consequences of the flood inundation. Finally, since the ability to deploy extensive sensor networks would be limited due to cost considerations, the results of the proposed framework could inform about areas in which other sensing techniques (social sensing and remote sensing could be used to enhance flood monitoring and situational awareness based on an improved network observability).

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Question 1

Write about how flood control network is monitored and how the authorities use the data collected.

Espaço para Resposta

Question 2

Explain what observability is and present the objective of infrastructure observability.

Espaço para Resposta

Question 3

Explain what the researchers’ proposed framework was and what it consists of.

Espaço para Resposta

Question 4

Write about the four ways in which this research study’s findings can be used.

Espaço para Resposta

Question 5

Translate the excerpt below. The translated text should be clear and accurate in terms of structure and meaning.

> *A significant proportion of losses caused by natural disasters are related to flood events in urban regions. Thus, floods are a substantial threat to urban areas because they endanger the functionality of urban infrastructure systems and pose significant risks to the social well-being of the community. Climate change also drives the increasing risk of devastating floods. Besides, rapid urbanization introduces changes to cities' physical and social schemes such as infrastructure development and population density across the city.*

Espaço para Resposta