Organizational Features in the Management of Infrastructure Safety

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Abstract. The topic dealing with the infrastructure safety is one of the most relevant arguments in the governance of a geographical area where many structural systems have been built over time. Indeed, many structural systems often present safety or functionality critical issues and specific interventions are required to prevent undesirable social consequences. In this context, the stakeholders, i.e., public or private actors and institutions, are strongly involved in both the economic and administrative procedures. This contribution preliminarily provides some enhancements to improve the management of the infrastructures safety. Specifically, analyzing an Italian case study, the study proposes to adopt the remote sensing through satellite-based sensor technologies for an analysis at territorial scale. In this way, the territorial point of view on the critical issues affecting the infrastructures leads to involve the stakeholders to attain a wider degree of organization in the governance and management processes.

INTRODUCTION

Nowadays, the topic dealing with the infrastructure safety is one of the most relevant arguments in the governance of a geographical area where many structural systems (e.g., bridges, roads, viaducts and highways) have been built over time. Indeed, many structural systems often present safety or functionality critical issues and specific interventions are required to prevent undesirable social consequences, as discussed in [1-5].

In this context, the stakeholders, i.e., public or private actors and institutions, are strongly involved in both the economic and administrative procedures as explained in the following. In [6-7], public planning activities have proposed policies to ensure protection against natural hazards, adopting also risk-based approaches with the GIS (Geographical Information System) technique [8-9]. In [10], an integrated and systemic management approach for safety and security of roadway infrastructures is proposed.

Public and private stakeholders have additionally defined different strategies, denoted as Bridge Management Systems, in combination with the Structural Health Monitoring techniques [11-12], such as, the remote sensing through satellite-based sensor technologies, i.e., the Differential Interferometry Synthetic Aperture Radar (DInSAR) [13-14].

This contribution preliminarily provides some enhancements to improve the safety management of the road infrastructures at a territorial scale. Specifically, analyzing an Italian case study, the study proposes to adopt the DInSAR technique for territorial analyses. Along this line, the monitoring activity is useful to observe the infrastructures with respect to multi natural hazards or time-dependent processes (e.g., earthquake events, slow landslides, subsidence and soil-structure interaction or temperature effects, structural deterioration/degradation phenomena, season-induced effects) at territorial scale. Furthermore, the territorial point of view on the critical issues

affecting the infrastructures leads to involve all the stakeholders to attain a wider degree of organization in the governance and management processes.

THE DInSAR TECHNIQUE TO IMPROVE THE SAFETY MANAGEMENT OF THE INFRASTRUCTURES

The DInSAR technique [15-16] employs data attained by a satellite constellation (e.g., the Italian COSMOSkyMed) to obtain displacements measurements on the topographic surface, over time, caused by many possible hazards as explained in the previous section. These data, processed in GIS environment, lead to the definition of corresponding thematic maps of the infrastructures safety within a territorial context. These elaborations permit to recognise the stakeholders and improve the institutional organization in the governance and management processes of the geographical area. In fact, an appropriate safety management of the infrastructures at a territorial scale can be ensured by increasing the synergy between the public actors, different institutions and the various administration levels.

By this way, the stakeholders can delineate investment plans organised in respect with the different administrative competences specific for each criticism, which has to be evaluated by expert engineers to assess whether the displacements can negatively affect the infrastructures safety.

ITALIAN CASE STUDY: PRELIMINARY RESULTS

Considering some road infrastructures of Rome Municipality (Italy), within the research project [17], some results, having a preliminary value, attained from the DInSAR-based territorial analysis are discussed in the following.

Figure 1(a) illustrates GIS maps showing Rome Municipality together with the infrastructures. Table 1 reports the stakeholders involved: “ANAS S.p.A.”, “Strada dei Parchi S.p.A.”, “ASPI - AutoStrade Per l’Italia”, Province and Municipality.

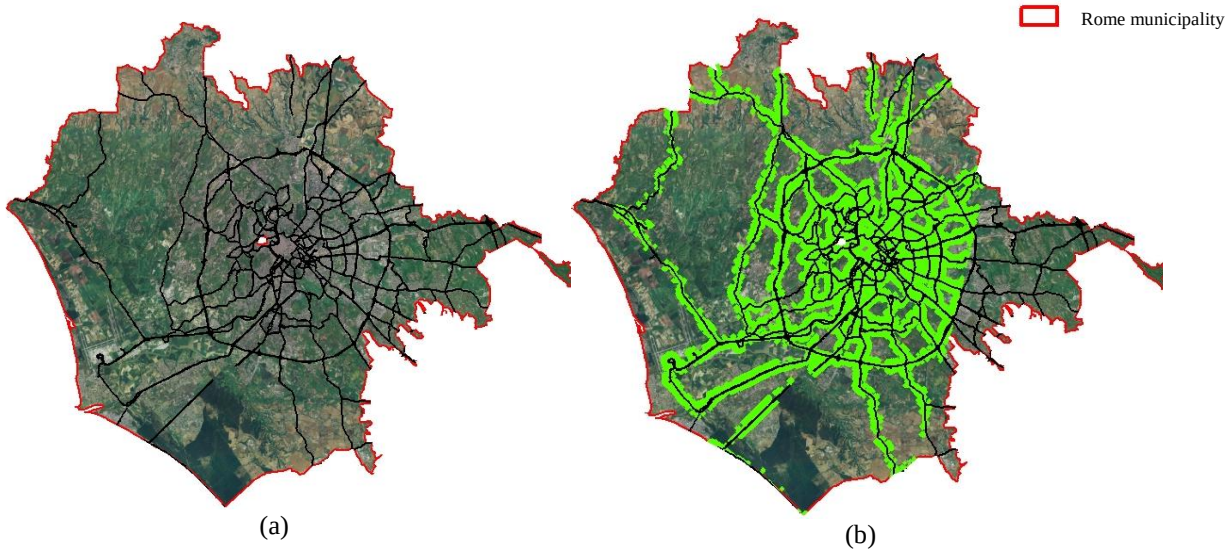

FIGURE 1. The infrastructures (a), monitored points (b).

On this GIS thematic map, we have properly elaborated the DInSAR data, with reference to the SAR sensor images (COSMO-SkyMED) related to the descending orbit within the last eight years. Selecting a value equal to 0.6 for the coherence [18], quite six millions of points have been monitored, as depicted in Figure 1(b).

In order to assess the displacements, the infrastructures and the territory have been divided into “cells” with a size of 50x50m [15,19]. Successively, through a processing of the data, the vertical displacements have been computed, as depicted in Figure 2, in full accordance with [15,19].

The results preliminarily indicate the potential damages since high vertical displacements affect some specific infrastructures. Additional and more specific analyses are necessary to evaluate the safety condition with respect to proper damage thresholds [5].

Although the preliminary value of these results, we can discuss the useful contributions of this satellite-based territorial analysis. In fact, this territorial investigation permits to relate the infrastructures to the stakeholders leading to a their direct involvement in the administrative process to define the most sustainable and appropriate investments, with a particular attention to the infrastructures with higher potential damages.

TABLE 1. Infrastructures and the corresponding stakeholders.

Infrastructures	Stakeholders
"Autostrada del Sole - A1"	"ASPI - AutoStrade Per l'Italia"
"Autostrada Azzurra - A12"	"ASPI - AutoStrade Per l'Italia"
"A91"	"ANAS S.p.A."
"A24"	"Strada dei Parchi S.p.A."
"Grande Raccordo Anulare"	"ANAS S.p.A."
"Maremmana - SP 216"	Province
"Lungotevere"	Municipalility
"Circonvallazione"	Municipalility

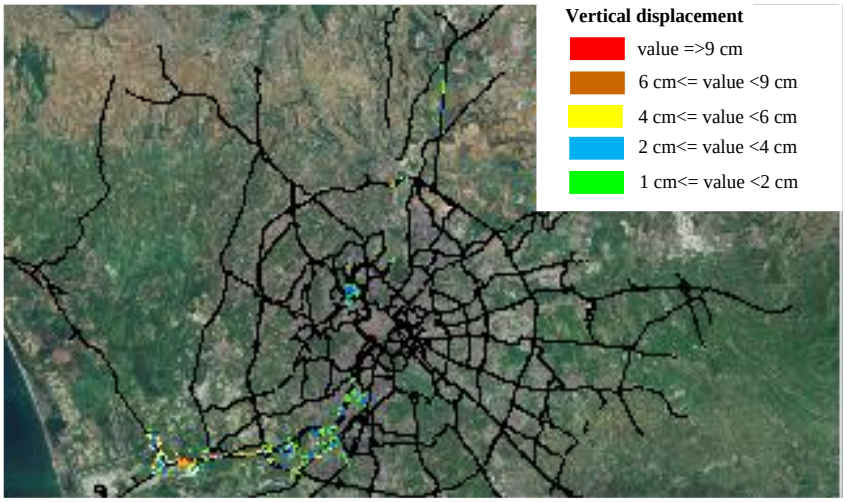

FIGURE 2. Vertical displacements.

CONCLUSIONS

The present work has the purpose to describe some preliminary improvements in the safety management of the infrastructures at a territorial scale. This issue is one of the most relevant arguments since many structural systems (e.g., bridges, roads, viaducts and highways) have been built over time and, nowadays, present safety or functionality critical issues. It follows that specific interventions are required to prevent undesirable social consequences.

In this context, the stakeholders, i.e., public or private actors and institutions, are strongly involved in both the economic and administrative procedures.

This study preliminarily investigates how the remote monitoring technique (i.e., DInSAR) is able to promote a wider degree of organization in the governance and management processes regarding the safety management of the infrastructures at a territorial scale.

The presented results, related to the Italian case study, demonstrate that the monitoring activity of the all infrastructures is able to promote a territorial contextualization of the infrastructures safety with a direct involvement of the actors.

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