UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II

DIPARTIMENTO DI STRUTTURE PER L'INGEGNERIA E L'ARCHITETTURA
CORSO DI DOTTORATO DI RICERCA IN
INGEGNERIA STRUTTURALE GEOTECNICA E RISCHIO SISMICO

XXXIX CICLO

Il sottoscritto prof. **Giovanni Forte** (PO □ PA □ RU □ RTD X) afferente al Dipartimento di **Ingegneria Civile, Edile e Ambientale (DICEA)**

S.S.D. **GEO/05 – Geologia Applicata**

Il sottoscritto prof. **Hakan Tanyas** (Assistant Professor) afferente a University of Twente, Faculty of Geo-information Science and Earth Observation (ITC), Netherlands

CHIEDONO

di essere inseriti nell'elenco dei tutor per il XXXVIII ciclo.

1. Curriculum dei proponenti (max 500 parole)

Giovanni Forte is Assistant Professor (RTD-B) of Engineering Geology at DICEA, University of Naples Federico II. He has a Bachelor in Earth Sciences (2008), a Master's degree in Geology and Engineering Geology cum laude in 2010. He is PhD in Seismic Risk (XXVI cycle) at University of Naples Federico II defending a thesis on "Integrated approach to the analysis of earthquake triggered landslides and their impact on roadway infrastructures" in 2014. He got the National Scientific Qualification (ASN) for the position of Full Professor on 1st February 2023.

Teaching activity
Since 2011 he supports the teaching activities of the engineering geology group. Since January 2018 he is Professor of the courses of **Engineering Geology** (Geologia Applicata) 6 CFU, **Geological Risks for the design of Civil Engineering works** (Rischi geologici nella Progettazione di Opere di Ingegneria Civile) 3/9 CFU for the bachelors and master degrees in civil, building and environmental engineering. Since 2021 he also teaches **Digital maps and geological 3D modelling** 9 CFU for the master in Transportation Engineering and Mobility.
He supervised more than 35 students for their graduation thesis for both bachelor's and master's degrees.

Research activity

The main scientific research topics deal with **natural hazards**, **slope stability**, **earthquake engineering** and **hydrogeology**. The results of the researches are presented in several national and international congresses and summarized in several indexed-journals. He participated in several Research Projects as: **AMABT** (FRA), **MASLIDE** (FRA), **ISTOS** (Horizon2020), **MITIGO** (PON), **RELUIS** (Department of Civil Protection), **VIRA** (Department of Civil Protection), **CLARITY** (Horizon2020), **GRISIS** (POR), **METROPOLIS** (PON).

Hakan Tanyas is a geotechnical engineer. He received his Ph.D. degree in Earth Sciences in 2019 from the University of Twente, Faculty of Geo-information Science and Earth Observation (ITC), Netherlands. During his Ph.D., he worked at USGS Colorado, USA, Golden office and CNR IRPI, Italy, Perugia office as a visiting scientist. In 2019, he was awarded a NASA Postdoctoral Program (NPP) Fellowship at the NASA Goddard Space Flight Center. After 2-year of postdoc experience, in 2021, he started working as Assistant Professor at ITC, University of Twente.

Teaching activity

He teaches MSc and PhD courses on natural hazards predominantly in international environments.

Research activity

His research primarily focuses on hazard assessment of landslides triggered by earthquakes. He developed the first global-scale repository of earthquake-induced landslide inventories. Also, he developed a proposal with the USGS team to create a web-based platform allowing data sharing for those landslide inventories. He was involved as a co-PI and the project was funded by the Community for Data Integration, which is a dynamic community working together to grow USGS knowledge and capacity in scientific data. He was involved in multiple research projects aiming at developing near real-time predictive models for earthquake-induced landslides. For isntance, as of July 2018, the USGS introduced a new tool, called Ground Failure, providing estimates regarding the distribution of coseismic landslides in near-real-time (https://earthquake.usgs.gov/data/ground-failure/background.php). He has recently started running an international NATO project targeting post-seismic landslide hazard assessment regarding February 6 Turkey-Syria earthquake sequences.

2. Dottorandi dei quali il proponente è stato tutor nell'ultimo triennio (Hakan Tanyas)	
n. 4	*International Grants*

3. Titolo della ricerca proposta
Innovative approach for seismic-induced rockfall hazard assessment

4. Area Tematica
Ingegneria Geotecnica □ Ingegneria Strutturale □ Rischio Sismico X

5. Tipologia di borsa per la quale si propone il progetto
Ateneo X DM 117 (Investimento 3.3) □ *(in questo caso indicare l'azienda co-finanziatrice)* DM 118 (Investimento 4.1 P.A.) □ DM 118 (Investimento 4.1 generici) □ DM 118 (Investimento 4.1 Patrimonio culturale) □

6. Sintesi del progetto di ricerca (max 500 parole. Stato dell'arte, breve programma previsto per le attività e obiettivi)
Earthquake-induced landslides (EQIL) are devastating phenomena that cause significant social and economic losses. Since earthquake prediction is still an intractable scientific

problem, when EQIL occur, near-real-time earthquake hazard maps are crucial for humanitarian agencies and decision-makers to facilitate mitigation actions in the affected areas. One of the fundamental layers in assessing EQIL hazard is the earthquake intensity map that shows the distribution of the earthquake waveform intensity. However, till now, the commonly used near-real-time information system provided by the USGS only uses a simplistic approach based on the ShakeMap service that depends basically on estimating the earthquake shaking by interpolating the intensity information from the waveforms recorded by seismic stations, local site characteristics, and the empirically driven ground motion equation. The ShakeMap system provides useful information on a regional scale when dense seismic stations coverage is available. However, seismic stations are usually sparsely distributed with tens of kilometres of interstation spacing on average, even for well-covered regions. Therefore, in best-case scenario, the intensity-driven information from the ShakeMap system largely simplifies the complex variation in the earthquake waveform due to the source mechanism, topography, and/or subsurface structure. This can lead to significant amplification or focusing and de-focusing of the earthquake intensity, and therefore, it may also lead to a significant variation in the landslide distribution and their susceptibility mapping. Conversely, for areas poorly covered with seismological stations, the ShakeMap product could hardly provide any accurate information about the complex earthquake waveform intensity.

This project envisions the creation of a near-real-time simulator of seismic-induced-rockfalls. The idea will combine state-of-the-art seismic shaking data and probabilistic rockfall simulations. The latter will be based on a dual experimental test that will target two areas: (1) the recent disaster in Turkey-Syria occurred on February 06, 2023, due to an earthquake sequence of large magnitude; (2) the sector of central Italy hit by the seismic sequence occurred in 2016.

The differences between the two areas will lay the foundations for a doctoral thesis where two very different situations will be explored. For instance, in one case a LiDAR survey is available and therefore it would be possible to rely on high-res topographic data. The same is valid for the availability of seismic data. Furthermore, the project will involve an analytical protocol tested across various spatial scales. For instance, in the case of the Turkish landscape, agreements already exist with Istanbul Technical University for the deployment of seismic nodes. This would be crucial to extend the co-seismic

considerations to the post-seismic framework, thus opening up towards a holistic multi-hazard assessment tool as well as towards landscape evolutionary research.

The doctoral research is aligned with a large NATO project where international players from the Netherlands (ITC) and Turkey (ITU) will be involved in a large partnership.

7. Pubblicazioni sul tema di ricerca

1. Pignalosa A., **Forte G.**, Budetta P., Santo A. (2022). Topographic amplification and debris remobilization as a cause for increasing rockfall hazard in seismic areas: A case study in Central Italy. Geomorphology, 403, 108160. DOI 10.1016/j.geomorph.2022.108160.
2. **Forte G.**, Verrucci L., Di Giulio A., De Falco M., Tommasi P., Lanzo G., Franke K.W., Santo A. (2021). Analysis of major rock-slides that occurred during the 2016–2017 Central Italy seismic sequence. Engineering Geology, 290, 106194.
3. Licata V., **Forte G.**, d'Onofrio A., Santo A., Silvestri F. (2019). A multi-level study for the seismic microzonation of the Western area of Naples (Italy). Bulletin of Earthquake Engineering, 17(9), 4711-4741. DOI: 10.1007/s10518-019-00665-6.
4. **Forte G.**, Chioccarelli E., De Falco M., Cito P., Santo, A., Iervolino, I. (2019). Seismic soil classification of Italy based on surface geology and shear-wave velocity measurements. Soil Dynamics and Earthquake Engineering, 122, 79–93.
5. **Forte G.**, Fabbrocino, S., Silvestri, F., Santucci de Magistris, F. (2019). Assessment of seismic slope stability at different scales in Molise region (Southern Italy). Earthquake Geotechnical Engineering for Protection and Development of Environment and Constructions- Proceedings of the 7th International Conference on Earthquake Geotechnical Engineering, pp. 2452–2459.
6. **Tanyas, H.**, van Westen, C.J., Allstadt, K.E., Anna Nowicki Jessee, M., Görüm, T., Jibson, R.W., Godt, J.W., Sato, H.P., Schmitt, R.G., Marc, O., Hovius, N., 2017. Presentation and Analysis of a Worldwide Database of Earthquake-Induced Landslide Inventories. Journal of Geophysical Research: Earth Surface. 122. https://doi.org/10.1002/2017JF004236
7. **Tanyas, H.**, Rossi, M., Alvioli, M., van Westen, C.J. and Marchesini, I., 2019. A global slope unit-based method for the near real-time prediction of earthquake-induced landslides. Geomorphology, 327, pp.126-146. https://doi.org/10.1016/j.geomorph.2018.10.022
8. **Tanyas, H.**, Görüm, T., Kirschbaum, D., Lombardo, L., 2022. Could road constructions be more hazardous than an earthquake in terms of mass movement? Nat. Hazards. https://doi.org/10.1007/s11069-021-05199-2

9. **Tanyas, H.**, Kirschbaum, D., Lombardo, L., 2021. Capturing the footprints of ground motion in the spatial distribution of rainfall-induced landslides. Bulletin of Engineering Geology and the Environment. https://doi.org/10.1007/s10064-021-02238-x
10. Kun H., Lombardo, L., Chang, L., Sadhasivam, N., Hu, X., Fang, Z., Dahal, A., Fadel, I., Luo, G., **Tanyas, H.**, 2022. Hillslope recovery after a major earthquake: InSAR-derived time series analyses to capture earthquake-legacy effect. Earth ArXiv, Preprint. https://doi.org/10.31223/X5Q65W

8. Progetti di ricerca finanziati in cui l'attività si inserisce

The research activity is internally associated with the seismic slope stability studies (task 2 - WP16) performed in the framework of the Italian Department of Civil Protection ReLUIS-DPC 2022–2024 research project.

The research activity is externally associated with the NATO project "Post-Earthquake Monitoring of Seismically-induced Chains of Landslide Hazards (SHAKEN) for Protection of Critical Sites and Infrastructure".

9. Fondi disponibili per eventuali assegni, borse di ricerca, ecc., per acquisto eventuale di attrezzature, missioni

The research activity is supported by the abovementioned research project and additional funding for research mobility of the University of Twente.

10. Informazioni relative ad un periodo di ricerca all'estero (minimo tre mesi) previsto per il dottorando (*indicare Università/ente di ricerca e docente/ricercatore di riferimento*) (max 300 parole)

The PhD candidate is going to spend from 12 to 18 months in the Netherlands at the Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, Enschede to get access to their computing facility. During this period, assistant professors dr. Hakan Tanyas and dr. Luigi Lombardo from the Department of Applied Earth Sciences will provide co-supervision for the candidate.

10. Eventuali collaborazioni con imprese/aziende sul tema di ricerca (max 300 parole)

Napoli, 26/06/2023 FIRMA

Il presente modulo va compilato in ogni sua parte ed inviato all'indirizzo di posta elettronica phd.dist@unina.it entro e non oltre **Venerdì 30/06/2023**