

Geospatial Big Data and AI for Geothermal Exploration Dr. H. Sebnem Duzgun

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Abstract: The talk will outline the application of new machine learning techniques to analyze big geospatial data, namely, satellite images, geophysical and geological data, to develop a process to more accurately identify sites for geothermal exploration while reducing costs. The AI methods based on deep learning are very accurate. However, they require a large number of labeled data sets. In geosciences, labeling large data sets is a challenge. The talk will present a new methodology developed using statistical and machine learning (SML) methods to automatically label data from big geospatial data to be used in deep learning models. The automatic labeling approach requires an understanding of indicator parameters that indicate the existence and non-existence of a geothermal site. The talk will demonstrate the use of SML methods for identifying the indicator variables for geothermal exploration with a focus on compiling and processing big geospatial data (e.g., satellite, geological, geophysical, and drill hole data) for the three geothermal sites: Brady Hots Springs, Desert Rock, and the Salton Sea. The fault density, mineral markers, deformation, and land surface temperature, are four major indicators for the geothermal sites. The talk will emphasize specific machine learning and spatial statistical models to process satellite and geological data to obtain indicator layers. It will also demonstrate how these data sets are incorporated into labeling and prediction models. Then the results of deep learning algorithms in predicting geothermal sites will be presented. The developed deep learning model is based on the transfer learning approach. A trained network for a labeled data set is used for predicting other sites, without using additional training data from the other sites. The talk will show the results of AI for each site and show the results of a prediction for the Desert Peak site using an AI trained for the Brady site data.



Biography: Dr. H. Sebnem Düzgün, was born in Nazilli, Turkey and graduated the second in the class of 1992 from Department of Mining Engineering at Middle East Technical University (METU), Ankara, Turkey. She started her graduate studies in the Department of Mining Engineering and got her M.Sc. and PhD. Degrees in 1994 and 2000, respectively from the same department. She was a visiting scholar in the Department of Civil and Environmental Engineering at MIT from 1998 to 1999 with an award given by the Turkish Scientific and Technical Council (TUBITAK). She was appointed as assistant professor in Geodetic and Geographic Information Technologies Program at METU in 2001. She performed research as a postdoctoral fellow from 2004 to 2005 at Norwegian Geotechnical Institute and International Center for Geohazards with a grant from the Norwegian Research Council. She then returned to Department of Mining Engineering at METU in 2006 as associate professor and became full

professor there in 2010. Dr. Düzgün was awarded the Alexander von Humboldt Foundation's experienced researcher fellowship in 2014 and used it to conduct research at the Geophysical Institute at Karlsruhe Institute of Technology in Germany from 2015 to 2016.

She has been 18 years of experience in research and teaching in mining engineering on mine closure and reclamation, quantitative sustainability assessment for mining projects, risk and safety analysis for coal mines, mine environmental monitoring using remote sensing, reliability based design and analysis of rock slopes, uncertainty modeling in rock engineering, and interdisciplinary topics including geographic information systems, remote sensing, spatial and spatio-temporal data mining, landslide and earthquake risk assessment, critical infrastructure resilience. She is also on the Editorial Board of various scientific journals, namely *Landslides*, *Journal of Sustainable Mining*; *Computers and Geosciences*; *International Journal of Emergency Management*; *Georisk Journal*; *Energy Exploration & Exploitation*; and *The Open Construction and Building Technology Journal*.

Since 2008, Dr. Düzgün has been serving as an expert evaluator and reviewer for the FP7 and Horizon 2020 European Commission`s Research and Innovation Programs (including the themes ICT, Secure Societies, Critical Infrastructure and the RFCS-Research Fund for Coal and Steel). She is a member of SME, ARMA, ISRM, IEEE and ISPRS, USSD. Dr. Düzgün has authored four books, published 11 book chapters, more than 60 papers in peer-reviewed scientific Journals, over 150 papers in conferences. She is the principal author of the book entitled Remote Sensing of the Mine Environment. Dr. Düzgün`s recent research areas involve quantitative risk and resilience assessment for mining hazards and geohazards, big data analytics, Earth observation in geosciences, virtual/augmented/mixed reality (VR/AR/MR) and serious gaming for technical training and collaborative decision making. Dr. Düzgün has established the collaborative immersive VR laboratory at Mines. She was founder and former CEO of the software company, Kuzgun Informatics, in Turkey, contributor of the three ceramic art exhibitions, the drummer of a local band and is mother of two sons.