

**Research Team:**

The research team is made up of 14 people who set a multidisciplinary and international group of engineers (agronomists, civil, geographers, industrialists), mathematicians and statisticians from the Universities of Jaén ([www.ujaen.es](http://www.ujaen.es)) (Spain), Granada ([www.ugr.es](http://www.ugr.es)) (Spain), Federal do Paraná (<https://www.ufpr.br>) (Brazil) and ORT of Montevideo (<https://www.ort.edu.uy>) (Uruguay).

FunQuality4DEM includes a team of experts made up of producers and users of DEMs from public and private entities in Spain, Brazil and Chile and who have supported the application for this project.

**Promoters, observers and collaborators:**



**More information:**

[https://coello.ujaen.es/investigacion/web\\_giic/funquality4dem/](https://coello.ujaen.es/investigacion/web_giic/funquality4dem/)

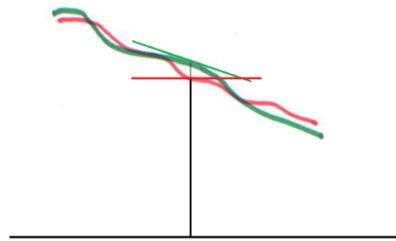
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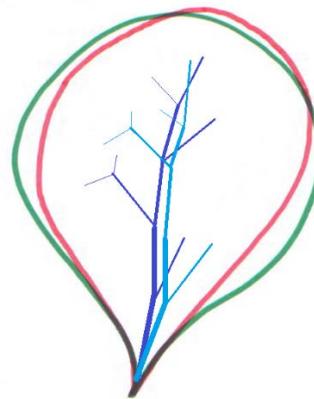
**Funding:**



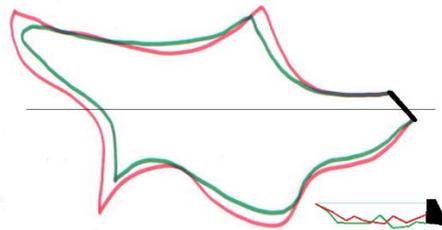
**USE CASES**



Heights, slopes, orientations



Basins and drainage networks



Dammed volumen

# FunQuality4DEM

Functional Quality of Digital Elevation Models in Engineering



Ministry of Science, Innovation and Universities  
Call 2019 << R+D+i Projects>>  
STATE PROGRAM FOR KNOWLEDGE GENERATION AND SCIENTIFIC AND TECHNOLOGICAL STRENGTHENING OF THE R+D+i SYSTEM AND THE R+D+i STATE PROGRAM FOCUSED ON THE SOCIETY CHALLENGES

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[https://coello.ujaen.es/investigacion/web\\_giic/funquality4dem/](https://coello.ujaen.es/investigacion/web_giic/funquality4dem/)

## Introduction

Some Society Challenges, where spatial data and specifically digital elevation models (DEM) support numerous decisions, range from climate change, earthquakes, floods, thaw evaluation, forest fire evaluation, deforestation, desertification, civil protection, land use planning, Common Agricultural Policy, International Emergency Aid, crises, etc. Spatial data is considered as an essential element for good governance by the World Bank, the European Union, the United Nations, etc. and DEMs is a key spatial data “issue”.

Spatial data is an important component of Environmental Intelligence technologies as it provides ubiquity and context to records from non-spatial sensor networks. According to European and American environmental agencies, quality is a key component of spatial data and, from a scientific point of view, a Challenge.

The functional quality concept refers to the DEMs ability to provide useful results for users after performing analysis and spatial modeling operations (e.g. drainage network, river basin, etc). Users would like to know if such DEM data will actually produce quality results for their modeling (e.g. erosion, floods, water balance, etc.). Therefore, for specific users to better understand the quality of a DEM, new measures are required that do have a direct relationship with the results of the application. So, the **project objective** of FunQuality4DEM is to develop methods for evaluating and reporting the functional quality of DEM on certain use cases.

**The novelties of this proposal** are summarized in: 1) raise the quality of the DEM data from a functional perspective (GIS analysis operations); 2) propose and formalize new methods for assessing the quality of DEM based on the use of surfaces and lines; 3) propose and formalize new measures and ways of reporting on DEM data quality from a multivariate perspective, local and oriented to specific USE CASES.

## Use cases

Since there are many users and varied uses of DEM data, this project focuses on a small but significant set of use cases:

1. **Estimation of single values.** This case refers to the selection of the height, slope and orientation in isolated points or sets of points. These are simple operations that comprise a large percentage of DEMs use.
2. **Computation of drainage networks and hydrographic basins.** Both the drainage network and the hydrographic basin are based on the knowledge of the flow directions model and their results are highly conditioned by the algorithms used. DEM data is considered in "extended neighborhood". The engineering applications of drainage networks and hydrographic basins are countless (e.g. floods calculation) and of great economic, social and environmental relevance.
3. **Volume estimation.** DEMs are used to compute cuts, embankments, dammed volumes, etc. For example, reliable knowledge of impounded water volume is a frequent problem that reservoir managers have to deal with, when they make the decision on how much water to drain. However, on many times, due to poor quality DEM data, erroneous estimates are computed and thus inadequate decisions are made.

In this way, the FunQuality4DEM project addresses three very different types of DEM data use (isolated points, neighborhoods / surfaces and volumes).

## Objectives

The general objective of the FunQuality4DEM project is to develop methods for evaluating and reporting the DEM functional quality, such that users get a better understanding of the goodness of DEM data before using it.

The following specific objectives are addressed:

1. **Identify implicit approaches** to the DEM functional quality for the established use cases, and proceed with their formalization.
2. **Develop** a method for evaluating the accuracy of mesh DEMs based on patch sampling.
3. Analyze **local similarity** by techniques that automatically identify and find homologous elements between mesh DEMs.
4. Analyze the **global and local multivariate similarity** in order to make comparisons closer to the needs of the DEM users.
5. Define and develop **approaches to regionalize DEMs** such that they allow to locally information on the different aspects of quality.
6. **Fit the elevations surface** by means of functions to use the fitting parameters as features of the surfaces and their variations.
7. Select and propose a **set of measures** to be combined or expressed jointly, and validate them as functional quality indexes on use cases supported by expert knowledge.

## Expected results

The main expected result of FunQuality4DEM is to get better quality evaluation and reporting methods, generating technical documents (reports, proposals for standards, etc.) and tools (e.g. plugins) that allow applying the conceptual achievements to the daily tasks of producers and users.