

# VxC TSG Image Database

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In this document we present the VxC TSG image database (VxC Tiles for Surface Grading). Building this database has been one important goal of the thesis “Real-time Surface Grading of Ceramic Tiles”. The VxC TSG is based on samples taken from the ceramic tile industry and is comprised of 14 ceramic tile models, 42 surface grades and 960 pieces. It was built in the VxC laboratory in collaboration with Keraben S.A. and is an extensive image database of ceramic tiles representing the wide range of surface classes in the ceramic tile industry. VxC TSG is also intended to be a tool for the scientific community working on surface grading. It is public and available at [miron.disca.upv.es/vision/vxctsg/](http://miron.disca.upv.es/vision/vxctsg/).

## 1 Surface grading

In recent years, automatic inspection systems have become of paramount importance for industries with serial productive plans. These industries are commonly characterized by the following items:

- Complex processes formed by multiple stages at production lines.
- High production rates.
- High added value of every piece.
- Quality control stage for the final product.
- 100% inspection at factory rates.

The ceramic tile industry is one clear example of this type of productive systems. However, factories continue to use human inspectors to grade tile quality. In this industry the great majority of tile faults are surface defects, thus, surface inspection is an important quality control subject to automate. But, this is a complex work which is divided into several tasks due to the diversity of existing surface faults. *Surface grading* is one of the most important issues of surface inspection.

There are many industries manufacturing flat surface materials that need to split their production into homogeneous series grouped by the global appearance of the final product. These kinds of products are used as wall and floor coverings.

Some of them are natural products such as marble, granite or wooden boards, and others are artificial, such as ceramic tiles.

In these industries the quality control stage is crucial in remaining competitive. One of the most important quality problems is the non-uniformity of the visual aspect of the product within the same lot of a specific model. As the final product is used to form areas which are supposed to be uniform in appearance, the presence of pieces which look slightly different is considered a serious quality defect.

Surface grading is related with the automatic classification of flat pieces presenting random, pseudo-random or fixed surface patterns. The aim of surface grading is to split the production into different classes sorted by their global appearance which depends on colour and texture properties.

Before describing the image database itself, we describe the acquisition system used to capture the digital images of tiles.

## 2 Acquisition system

The acquisition system (see Figure 1) compromises the following high quality components:

- One Dalsa Trillium camera (TR-31-02k25). This is a colour scan line camera with 3 CCDs (RGB). It provides 2048 pixels of horizontal resolution and a maximum acquisition rate of 11kHz. We used a resolution of 3.2 pixels per millimetre in images.
- One Nikon optics (35mm, 1:2.0 mm).
- One Coreco-Imaging PC-DIG frame grabber with 4Mb of internal RAM and 100MB/s of PCI transfer rate.
- High frequency and uniform fluorescents (Mercrom FXC2372-2). This illumination system has two special high frequency fluorescent lamps (60kHz) with uniform illuminance throughout its length. To overcome variations with time, the power supply is automatically regulated by a photoresistor located near the fluorescents.

Figure 1: Acquisition system.

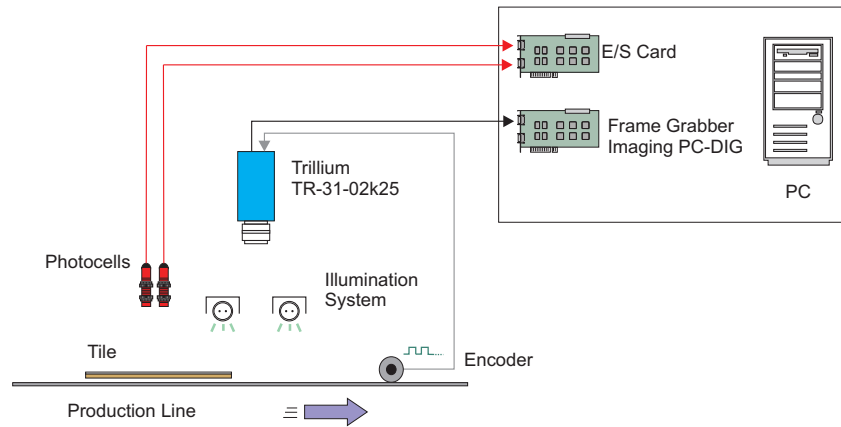
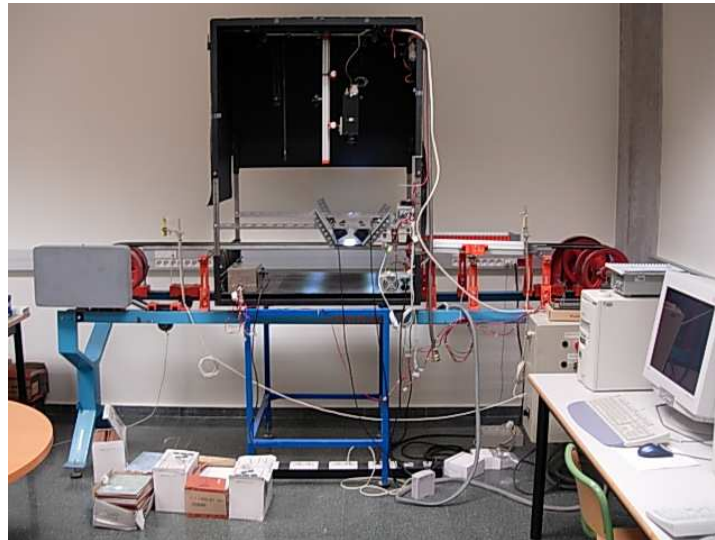


Figure 2: Prototype at VxC laboratory.



In the VxC laboratory there is a prototype system which is a replica of a section of a typical ceramic tile production line. The prototype comprises a cabin integrated in the production line as the acquisition unit (see Figure 2) and one PC with the frame grabber and the I/O card as the processing unit. This prototype with the above mentioned components has been used to capture the digital images for the VxC TSG database.

### 3 VxC TSG description.

Table 1: Models of the VxC TSG image database.

	<b>classes</b>	<b>tiles/class</b>	<b>size (cm)</b>	<b>pattern</b>	<b>aspect</b>
agata	13, 37, 38	16	33x33	fixed	marble
antique	4, 5, 8	14	23x33	pseudo-random	stone
berlin	2, 3, 11	24	20x20	random	granite
campinya	8, 9, 25	30	20x20	pseudo-random	stone
firenze	9, 14, 16	20	20x25	random	stone
lima	1, 4, 17	24	20x20	random	granite
marfil	27, 32, 33	14	23x33	pseudo-random	marble
mediterranea	1, 2, 7	30	20x20	random	stone
oslo	2, 3, 7	24	20x20	random	granite
petra	7, 9, 10	28	16x16	random	stone
santiago	22, 24, 25	28	19x19	random	stone
somport	34, 35, 38	28	19x19	random	stone
vega	30, 31, 37	20	20x25	fixed	marble
venice	12, 17, 18	20	20x25	pseudo-random	marble

The image database has been built in collaboration with Keraben S.A. which is a large ceramic tile company (2nd in Spain by total turnover) located at Nules, province of Castellón. Together with the R+D staff we studied their catalog and chose a set of models intended to be a good representation of the wide variety of surface classes that factories can produce. A catalog of 700 models is common in these companies. But, in spite of this great number of models, almost all of them imitate one of the following mineral textures; marble, granite or stone.

Due to the way that tiles are produced there are three basic types of surface patterns; fixed, random and pseudo-random. Fixed pattern models are produced by impressing the fix decorative motives on to the enameled tile surfaces. This is done through silk-screen machines. Printing rollers are used to made pseudo-random models. The patterns on the rollers are fixed but the part of each roller that is impressed over the tile is randomly chosen by the moment that tile begin to pass under the rollers. For random models several techniques may be used depending on the model to be produce. One of these techniques consists of spreading pigments over the tile using sponges. From the point of view of surface grading purposes fixed and pseudo-random pattern models can be considered subsets of random pattern models.

The database is formed by the digital images of 960 tiles acquired from 14 different models, each one with three different surface classes (see Table 1). The classes were given by specialized graders at the factory. Every model has two close classes and one class distant to them. Surface classes (grades) are represented by numbers and close numbers mean close classes. Thus, the database include “difficult to discriminate” cases in each model. The tiles were

collected directly from the end of the production line, just before the tiles are graded and packed, or from stock stored at the factory.

Figures 3, 4, 5 and 6 show VxC TSG samples itemized by aspect. Quality of images was improved enhancing brightness and contrast independently in every model.

In the case of granite models there were only six tiles per surface grade. The size of these pieces was large, 50x50cm. To increase the number of samples in these models we decided to take four sub-samples of each piece with a size of 20x20cm. This could be done because grains and tile colour were uniformly distributed through all the surface of tiles.

Figure 3: VxC TSG marble samples. From up to down; three samples of agata, marfil, venice and vega models, each one corresponding to a different surface grade.



Figure 4: VxC TSG granite samples. From up to down; three samples of berlin, oslo and lima models, each one corresponding to a different surface grade.



Figure 5: VxC TSG stone samples. From up to down; three samples of antique, campinya, firenze and mediterranea models, each one corresponding to a different surface grade.

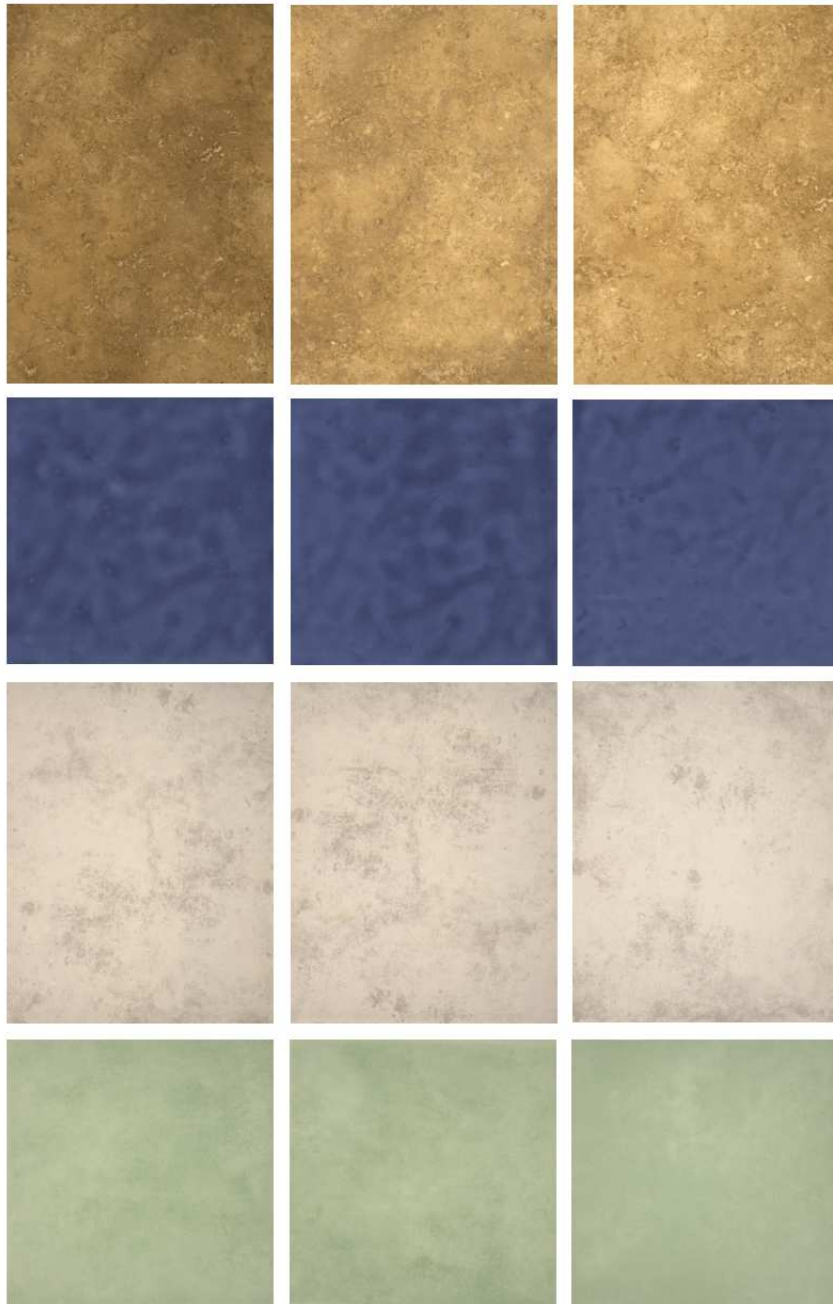


Figure 6: VxC TSG stone samples. From up to down; three samples of petra, santiago and somport models, each one corresponding to a different surface grade.

