Chapter 6
Decay Detection in Citrus Fruits Using Hyperspectral Computer Vision

Juan Gómez-Sanchis
Intelligent Data Analysis Laboratory, Universidad de Valencia, Spain

Emilio Soria-Olivas
Intelligent Data Analysis Laboratory, Universidad de Valencia, Spain

Delia Lorente-Garrido
Instituto Valenciano de Investigaciones Agrarias, Spain

José M. Martínez-Martínez
Intelligent Data Analysis Laboratory, Universidad de Valencia, Spain

Pablo Escandell-Montero
Intelligent Data Analysis Laboratory, Universidad de Valencia, Spain

Josep Guimerá-Tomás
Intelligent Data Analysis Laboratory, Universidad de Valencia, Spain

José Blasco-Ivars
Instituto Valenciano de Investigaciones Agrarias, Spain

ABSTRACT

The citrus industry is nowadays an important part of the Spanish agricultural sector. One of the main problems present in the citrus industry is decay caused by Penicillium digitatum and Penicillium italicum fungi. Early detection of decay produced by fungi in citrus is especially important for the citrus industry of distribution. This chapter presents a hyperspectral computer vision system and a set of machine learning techniques in order to detect decay caused by Penicillium digitatum and Penicillium italicum fungi that produce more economic losses to the sector. More specifically, the authors employ a hyperspectral system and artificial neural networks. Nowadays, inspection and removal of damaged citrus is done manually by workers using dangerous ultraviolet light. The proposed system constitutes a feasible and

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implementable solution for the citrus industry; this has been proven by the fact that several machinery enterprises have shown their interest in the implementation and patent of the system.

INTRODUCTION

The citrus industry, with an annual production over 89 million tons, is the most important of the World regarding fruits and vegetables production, giving an idea of its relevance on the World economy. It is relevant too on the European Union, where its production arises sums around 10 million tons, of which the 35% is produced on the Valencian Region.

In fact, Spain is the first World fresh citrus exporter, with the 34% of the global market, and the fourth in production level. According to sources of the Generalitat Valenciana, during the 2006-2007 season, the valencian citrus production increased to 4.2 tons (Figure 1), which represents the 80% approximately of the total citrus production in Spain. If only the data of the most important citrus is observed, the Comunitat Valenciana exported the 89% of the oranges and the 97% of the mandarins.

Of these exportations, the 82% approximately is addressed to European Union countries, while the rest is exported to so different countries as Japan or Canada, where the valencian citrus have strongly penetrated and have a market more and more important. As an example, the exportations to a so demanding market as the United States of America have risen from 4,200 to 80,000 tons in the last 10 years. This fact is due to the effort done by the producers in order to offer products of greater quality and by the researches, both from the point of view of the fruit, and from the technology for its cultivation.

The most of this effort has been focused on getting varieties resistant to plagues or illnesses or varieties marketable out of its usual period, on the biological fight against plagues and on

Figure 1. Estimation and balance of the production of citrus
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