中国农业工程学会
Chinese Society of Agricultural Engineering
农业工程学报
Transactions of the Chinese Society of Agricultural Engineering

基于小波变换的Wiener滤波方法在农产品图像去噪中的应用

Application of wavelet transform-based Wiener filtering method to denoise in agricultural product images

投稿时间：2006-5-25　　最后修改时间：2006-11-8

稿件编号：20070229

中文关键词：小波变换； Wiener滤波； 图像去噪； 红枣； 杂草

英文关键词：wavelet; Wiener filtering; image denoising; Chinese date; weed

基金项目：西北农林科技大学优秀人才基金(04ZR003)；青年学术骨干基金和校长基金；教育部高等学校博士点专项基金(20040712001)

作者	单位
杨福增	(1966-)，男，博士，博士后，副教授，硕士生导师，主要从事农业工程现代化、图像处理与小波变换研究。杨凌西北农林科技大学机械与电子工程学院16＃，712100。Email:yfz0701@163.com
王峥	陕西杨凌人，工学硕士。杨凌西北农林科技大学机械与电子工程学院16#，712100
杨青	西北农林科技大学机械与电子工程学院，杨凌 712100
张艳宁	西北工业大学计算机学院陕西省语音与图像信号处理重点实验室，西安 710072

中文摘要：

农产品图像的去噪是农产品图像处理中最基本、最重要的工作之一。为了更有效地去除农产品图像中的噪声。受二维离散Wiener滤波器计算方法的启发，提出了一种基于小波变换的Wiener滤波方法。该方法采用小波变换和Wiener滤波相结合的方法，具有稀疏性、多分辨率、去相关性、选基灵活性和在MSE意义上对图像进行最优估计的优点。该方法首先对含噪农产品图像ano做第一次小波变换得到低频图像a1和水平、垂直和对角三方向的高频图像 hd1、vd1及dd1；其次对低频图像a1做Wiener滤波得到a1w,再对3个高频图像分别做Wiener滤波并合成得到g1w ；接着对低频的a1w和高频g1w做小波逆变换，得到滤波图像“a1w+g1w”。同时，考虑到噪声主要在高频部分，所以直接把低频的a1和高频g1w做小波逆变换，得到滤波图像“a1+g1w”。这是对含噪图像ano做第1次小波变换的情况，其第2次、第3次及第4次变换的情况与此类似。这样可以得到许多滤波图像，然后根据图像信噪比PSNR和视觉效果，最终确定去噪效果最好的农产品图像。该方法应用于红枣、小麦杂草等农产品图像的去噪中，结果PSNR为158.23(视觉效果清晰)，好于邻域平均法(PSNR 为154.14)、中值滤波法(PSNR 为155.82)、数学形态学(PSNR为154.07，视觉效果偏黑)、高斯滤波法(PSNR为153.79，视觉效果太黑)、直接维纳去噪(PSNR为154.14)和小波去噪(PSNR为158.18)等多种方法。试验结果表明，基于小波变换的Wiener滤波方法应用于农产品图像去噪具有信噪比高、视觉效果好等优点；基于小波变换的Wiener滤波方法用于农产品图像去噪是有效的、可行的。

英文摘要：

Denoising is one of the most basic and the most important task in the agricultural product image processing. In order to effectively denoise in the agricultural products image, enlightened from two-dimensional discrete Wiener Filter arithmetic, the authors put forward a wavelet transform-based Wiener Filtering method. The method combined wavelet transform with Wiener filtering, and had the advantages of sparseness, multi-resolution, getting rid of pertinence, flexibility in choosing basis, and optimum estimation of image from the meaning of MSE. First, agriculture noise image "ano" was processed by wavelet transform to have a low frequency image "a1" and three high frequency images "hd1", "vd1" and "dd1" from horizontal, vertical and diagonal directions; Second, low frequency image a1 was processed by Wiener Filtering to have a image "a1w", then three high frequency images were processed separately by Wiener Filtering and compounded to a image "g1w"; Third, low frequency image "a1w" and high frequency image "g1w" were transformed conversely by wavelet to a filtering image "a1w+g1w". Simultaneously, considering noise presents to high frequency mostly, so low frequency image a1 and high frequency image "g1w" were transformed conversely by wavelet to a filtering image "a1+g1w". This was the instance of wavelet transform to noise image for the first time, and the second, third and fourth transform were resemblant. In this way, people can have many filtering images, then finally made sure the best denoised agricultural product images according to image signal-to-noise(PSNR) and visual effect. The method was applied in agricultural product image denoising such as Chinese date and wheat weed, as a result PSNR was 158.23(visual effect was clear), and better than other methods such as neighborhood average(PSNR was 154.14), median filter(PSNR was 155.82), mathematical morphology(PSNR was 154.07, visual effect was a bit black), Gauss filter(PSNR was 153.79, visual effect was very black), direct Wiener filter(PSNR was 154.14) and wavelet denoise(PSNR was 158.18) etc. The experimental results show that wavelet transform-based Wiener filtering metho

d applied in agricultural products image denoising has the advantages of high signal-to-noise, good visual effect; so wavelet transform-based Wiener filtering method applied in agricultural product image denoising is effective and practicable.