

# **Embedded Watermarking for Image Verification in Telemedicine**

by

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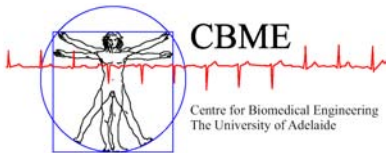
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# Abstract

Wireless communication technology has provided increased opportunity for applications such as telemedicine. This work focuses on the end application of teleradiology, targeting the communication of digital diagnostic images to remote locations for diagnosis and treatment. Medical images have conventionally been of large size and stored without loss of redundancy. Recent research has demonstrated that acceptable levels of Joint Picture Experts Group (JPEG) compression may be used on these image types without loss of diagnostic content. This has provided an opportunity for more rapid image transmission in wireless environments. One of the most pressing challenges that remain are techniques to verify the integrity of crucial diagnostic feature information that may be compromised with excessive use of standard compression methods.

An authentication watermarking technique is presented, which extracts critical feature information from the Region of Interest (ROI) and embeds a series of robust watermarks into the Region of Backgrounds (ROB) surrounding this location. This thesis will consider only the effects of distortions due to compression standards and presents a body of work that is a step towards a future study for considering compression together with channel noise introduced by the wireless environment.

The following key contributions have been made in this thesis:

- A novel technique to provide crucial feature authentication without introducing embedding distortions into these regions by using multiple robust watermarks
- Improved performance over earlier methods including superior robustness to DCT quantisation and complete JPEG image compression. Image fidelity is significantly improved with less distortion introduced. Smaller signatures can be used to authenticate essential image information than with conventional methods, decreasing overall system complexity
- Optimised JPEG survival levels that allow permissible JPEG compression levels to be specified.



# Statement of Originality

This work contains no material that has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of the thesis, when deposited in the University Library, being available for loan, photocopying and dissemination through the library digital thesis collection.

Dom Osborne

8th September, 2005

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Signed

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Date



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# Conventions

This thesis is typeset using the L<sup>A</sup>T<sub>E</sub>X2e software. WinEdt build 5.4 was used as an interface to L<sup>A</sup>T<sub>E</sub>X. Graphs and plots were generated using Matlab 7.0 (Mathworks Inc.) CorelDRAW 12 and Corel PHOTO-PAINT 12 were used to produce schematic and flow diagrams. The Kakadu JPEG-2000 software (David Taubman 2001) was used for the compression of imagery using an implementation of Part 1 of the JPEG-2000 standard.

The Harvard style is used for referencing and citation in this thesis. Australian English spelling is adopted, as defined by the Macquarie English Dictionary (Delbridge *et al.* 2001).





# Publications

- OSBORNE-D.**, ROGERS-D., AND ABBOTT-D. (2005a). Embedded watermarking for wireless image content authentication, *WSEAS Transactions on Communications*, **4**(7), pp. 505–513.
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