OPTIMIZED RESOURCE ALLOCATION
IN WIRELESS SYSTEMS

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A THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Faculty of Engineering and Information Technology,
University of Technology, Sydney
Australia

January 2013
Abstract

Modern wireless systems rely to a great extent on the judicious distribution of available resources (e.g. power, bandwidth) to meet an ever increasing demand of better quality-of-service (QoS). Scarcity of these resources with time, coupled with the tremendous growth in numbers of users, network throughput, and applications, have resulted in making the problem of optimal resource allocation extremely important especially in wireless networks.

Generally, optimization problems posed in the resource allocation framework are nonconvex and thus render it difficult to find an optimal solution. Previous studies on this subject have reported only numerically cumbersome and non-tractable solutions. This dissertation attempts to exploit the hidden convexity of the resource allocation problems under some given performance criteria such as minimum mean square error (MMSE) or signal-to-interference-plus-noise ratio (SINR) and then successfully finds tractable optimization formulations.

The first research problem deals with the optimal power allocation and sensor assignment in linear and nonlinear networks for static and dynamic target tracking. The proposed method casts power allocation as a semi-definite program (SDP) while sensor selection is solved via d.c. (difference of convex functions sets) programming. The second problem considers optimal beamforming and source power allocation in relay-assisted multiuser communication. This problem is further extended to include multiple-antenna systems to exploit spatial diversity in modern cellular communication by jointly optimizing source precoding and relay processing matrices. Supremacy of the proposed d.c. programming based iterative algorithm over existing methods is demonstrated via extensive simulations.
Originality Statement

‘I hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the award of any other degree or diploma at UTS or any other educational institution, except where due acknowledgement is made in the thesis. Any contribution made to the research by others, with whom I have worked at UTS or elsewhere, is explicitly acknowledged in the thesis. I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the project’s design and conception or in style, presentation and linguistic expression is acknowledged.’

Signed: Umar Rashid
Date: May 23, 2013
Acknowledgements

First and foremost, I would like to thank Almighty Allah Subhanahu Wataala for His countless bounties and blessings upon me. Then I am grateful and proud for being Ummati of my Lord Prophet Muhammad (Sallal Lahu Alaih-e-Wasallam).

I also express my sincere gratitude and appreciation to my supervisor, Professor Hoang D. Tuan, for all the guidance and encouragement he has offered me throughout the period of this research. In addition to learning tricks of the trade, I have tremendously benefited from him in terms of acquiring essential skills for my professional life.

I am also grateful to my co-supervisor Dr H. H. Kha for his valuable contribution and technical assistance throughout my whole PhD tenure. He has actively participated in almost all of my research publication for which I am greatly indebted to him. I am thankful to Professor Ha H. Nguyen from University of Saskatchewan, Canada for his contribution in my projects on relay beamforming for multiuser communication. He has also been a mentor and a constant contributor in my research work. I am also obliged to Professor Pierre Apkarian from Institut de Mathématiques, Université Paul Sabatier, France for his guidance and assistance in the field of nonlinear filtering in data fusion problems.

I would also like to take this opportunity to extend my thanks to Dean of Faculty of Engineering and Information Technology at University of Technology, Sydney, Professor Hung Nguyen who granted me tuition waiving scholarship which enabled me to fully focus on my research. My gratitude also goes to the generous financial support provided by Australian Research Council (ARC) Discovery Project for my graduate studies. I am thankful to them for putting their faith in my capabilities and I hope I have delivered.

Finally, I would like to thank my parents for their constant love and support, and for encour-
aging me to pursue higher studies.
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# List of Acronyms

**Acronyms**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>SN</td>
<td>Sensor Network</td>
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<tr>
<td>FC</td>
<td>Fusion Center</td>
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<tr>
<td>MMSE</td>
<td>Minimum Mean Square Error</td>
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<tr>
<td>SDP</td>
<td>Semi-definite Programming</td>
</tr>
<tr>
<td>DCP</td>
<td>Difference of Convex Programming</td>
</tr>
<tr>
<td>UKF</td>
<td>Unscented Kalman Filter</td>
</tr>
<tr>
<td>LMI</td>
<td>Linear Matrix Inequality</td>
</tr>
<tr>
<td>LFT</td>
<td>Linear Fractional Transformation</td>
</tr>
<tr>
<td>SINR</td>
<td>Signal to Interference Plus Noise Ratio</td>
</tr>
<tr>
<td>SDR</td>
<td>Semidefinite Relaxation</td>
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<tr>
<td>MIMO</td>
<td>Multiple Input Multiple Output</td>
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<td>s.t.</td>
<td>Subject to</td>
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