LIST OF FIGURES

2.1 Impulse Responses of Linear Phase FIR Filter 24
2.2 Magnitude response Specifications 26
2.3 Remez Exchange Algorithm 30
2.4 Windowing Method 32
2.5 Bar chart for N by GA and Remez 39
2.6 Magnitude Response by GA and Remez 40
2.7 Codec Filter by CSD 47
2.8 (a) Magnitude Response of Level 0 using Remez Algorithm 48
2.8 (b) Magnitude Response of Level 0 using GA 48
2.9 (a) Magnitude Response of Level 1 using Remez Algorithm 48
2.9 (b) Magnitude Response of Level 1 using GA 48
2.10 (a) Magnitude Response of Level 2 using Remez Algorithm 49
2.10 (b) Magnitude Response of Level 2 using GA 49
2.11 (a) Magnitude Response of Level 3 using Remez Algorithm 49
2.11 (b) Magnitude Response of Level 3 using GA 49
3.1 Desired Frequency Response 53
3.2 Interpolated Frequency Response 53
3.3 Four Cases of Frequency sampling Grid Points 54
3.4 Specifications for a Frequency Sampling Filter 56
3.5 Magnitude Responses (one Coefficient : N=15, B=3) 64
3.6 Magnitude Responses (one Coefficient : N=33, B=3) 65
3.7 Magnitude Responses (one Coefficient : N=65, B=3) 65
3.8 Magnitude Responses (one Coefficient : N=15, B=4) 65
3.9 Magnitude Responses (one Coefficient : N=16, B=3) 66
3.10 Magnitude Responses (one Coefficient : N=16, B=4) 66
3.11 Magnitude Responses (two Coefficients : N=15, B=3) 66
3.12 Magnitude Responses (two Coefficients : N=33, B=3) 67
3.13 Magnitude Responses (two Coefficients : N=15, B=5) 67
4.1 (a) QMF Bank 71
4.1 (b) Typical Magnitude Responses 71
4.2 (a) Non-Overlapping Responses 72
4.2 (b) Overlapping Responses 72
4.3 Various Internal Signals and Aliasing Cancellation Mechanism in QMF Bank 74
4.4 Magnitude Response of Analysis Filter (LP) of (9,7) Filter Bank - Phase I 85
4.5 Magnitude Response of Analysis Filter (HP) of (9,7) Filter Bank - Phase I 85
4.6 Magnitude Response of Analysis Filter (LP) of (13,7) Filter Bank - Phase I 87
4.7 Magnitude Response of Analysis Filter (HP) of (13,7) Filter Bank - Phase I 87
4.8 Magnitude Response of Analysis Filter (LP) of (13,11) Filter Bank - Phase I 89
4.9 Magnitude Response of Analysis Filter (HP) of (13,11) Filter Bank - Phase I 89
4.10 Magnitude Response of Analysis Filter (LP) of (9,7) Filter Bank - Phase II 94
4.11 Magnitude Response of Analysis Filter (HP) of (9,7) Filter Bank - Phase II 94
4.12 Magnitude Response of Analysis Filter (LP) of (13,7) Filter Bank - Phase II 96
4.13 Magnitude Response of Analysis Filter (HP) of (13,7) Filter Bank - Phase II 96
4.14 Magnitude Response of Analysis Filter (LP) of (13,11) Filter Bank - Phase II 98
4.15 Magnitude Response of Analysis Filter (HP) of (13,11) Filter Bank - Phase II 98
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.16</td>
<td>Magnitude Response of Analysis Filter (LP) of (9,7) Filter Bank - Phase III</td>
<td>101</td>
</tr>
<tr>
<td>4.17</td>
<td>Magnitude Response of Analysis Filter (HP) of (9,7) Filter Bank - Phase III</td>
<td>101</td>
</tr>
<tr>
<td>4.18</td>
<td>Magnitude Response of Analysis Filter (LP) of (13,7) Filter Bank - Phase III</td>
<td>103</td>
</tr>
<tr>
<td>4.19</td>
<td>Magnitude Response of Analysis Filter (HP) of (13,7) Filter Bank - Phase III</td>
<td>103</td>
</tr>
<tr>
<td>4.20</td>
<td>Magnitude Response of Analysis Filter (LP) of (13,11) Filter Bank - Phase III</td>
<td>105</td>
</tr>
<tr>
<td>4.21</td>
<td>Magnitude Response of Analysis Filter (HP) of (13,11) Filter Bank - Phase III</td>
<td>105</td>
</tr>
<tr>
<td>4.22</td>
<td>Magnitude Response of Analysis Filter (LP) of (9,7) Filter Bank (without Code Gain Relaxation) - Phase IV</td>
<td>108</td>
</tr>
<tr>
<td>4.23</td>
<td>Magnitude Response of Analysis Filter (HP) of (9,7) Filter Bank (without Code Gain Relaxation) - Phase IV</td>
<td>108</td>
</tr>
<tr>
<td>4.24</td>
<td>Magnitude Response of Analysis Filter (LP) of (9,7) Filter Bank (with Code Gain Relaxation 10%) - Phase IV</td>
<td>110</td>
</tr>
<tr>
<td>4.25</td>
<td>Magnitude Response of Analysis Filter (HP) of (9,7) Filter Bank (with Code Gain Relaxation 10%) - Phase IV</td>
<td>110</td>
</tr>
<tr>
<td>5.1</td>
<td>Set of Non dominated and Dominated Solutions</td>
<td>118</td>
</tr>
<tr>
<td>5.2</td>
<td>General MOGA Scheme</td>
<td>119</td>
</tr>
<tr>
<td>5.3</td>
<td>Non dominated Solutions for (9,7) Filter Bank</td>
<td>122</td>
</tr>
<tr>
<td>5.4</td>
<td>Non dominated Solutions for (13,7) Filter Bank</td>
<td>122</td>
</tr>
<tr>
<td>5.5</td>
<td>Non dominated Solutions for (13,11) Filter Bank</td>
<td>123</td>
</tr>
<tr>
<td>6.1</td>
<td>Typical Pass band of Multirate Filters</td>
<td>130</td>
</tr>
<tr>
<td>6.2</td>
<td>Two Dimensional QMF Bank</td>
<td>132</td>
</tr>
<tr>
<td>6.3</td>
<td>Reconstructed Images for Energy Minimization</td>
<td>136</td>
</tr>
<tr>
<td>6.4</td>
<td>Reconstructed Images for Code gain Maximization</td>
<td>137</td>
</tr>
<tr>
<td>6.5</td>
<td>Reconstructed Images for Code gain Maximization</td>
<td>138</td>
</tr>
<tr>
<td>6.6</td>
<td>Reconstructed Images for Code gain Maximization</td>
<td>139</td>
</tr>
</tbody>
</table>
6.7  Reconstructed Images for Energy Minimization and Code gain Maximization 140
6.8  Reconstructed Images for Code gain Maximization and Energy Minimization 141
6.9  Reconstructed Images by MOGA 142
6.10 Reconstructed Images by MOGA 143
6.11 Reconstructed Images by MOGA 144
6.12 Pass band Support for 2D Low pass Filter 149
6.13 Magnitude Response of 2D Low pass filter (1D filter length : 13) 149
6.14 Magnitude Response of 2D High pass filter (1D filter length : 7) 149