<table>
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<tr>
<th>Control strategies for robot-assisted therapy</th>
<th>Examples for upper extremity</th>
<th>Examples for lower extremity</th>
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<td><strong>Assistance Strategies</strong></td>
<td>Position control</td>
<td>[17,18,20–22,24,25,34,45,51–70]</td>
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<td>Impedance-based channel</td>
<td>[17,18,56,80–82]</td>
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<td>Velocity-field channel</td>
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<td>Moving back wall</td>
<td>[45,50,55]</td>
<td>[71]</td>
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<tr>
<td>• Make task safer to allow practice</td>
<td>Passive gravity counterbalancing</td>
<td>[17,33,88,89]</td>
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<td>• Enhance somatosensory input in a way correlated with motor output</td>
<td>Active weight compensation</td>
<td>[18,92–94]</td>
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<td>• Increase task success to motivate practice</td>
<td>Counterpoise control</td>
<td>[23,96]</td>
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<td>• Provide appropriate challenge point for optimal learning</td>
<td>EMG-triggered impedance</td>
<td>[19,25,55,87]</td>
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<td>• Reinforce normative sensory-motor pathways</td>
<td>force proportional to EMG</td>
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<td>Counterbalance-based</td>
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<td>Modulate desired movement time</td>
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<td>adaptive assistance</td>
<td>Learn static model of weakness</td>
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<td></td>
<td>Adjust unstable force field gain</td>
<td>[110]</td>
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<tr>
<td>• Allow more repetitions, since participant completes movements more efficiently</td>
<td>Minimize sum of error and effort</td>
<td>...</td>
</tr>
</tbody>
</table>

| **Challenge-Based Strategies** | Resistance | Constant resistance | [33, 58–60, 81, 108, 123–126, 163] |
| | Viscous resistance | [45] | [127] |
| | Cancel gravity only as needed | [50,92–94,128] | [9] |
| • Increase neural and muscle plasticity by increasing activation and force | Resist asymmetric movements | ... | [131] |
| | Resist movement of unimpaired arm | [130] | ... |
| | Halt movement if off-axis forces are large | [96,102,113] | ... |
| • Discourage abnormal movements or disuse of impaired limb | Increase kinematic error | [133] | [132] |
| | Amplify visual representation of error | [135–137] | ... |
| | Increase limb phasing error | ... | [134] |

| **Haptic Simulation Strategies** | Simulate interaction with physical objects | [17, 18, 21, 63, 64, 138–144] | [15,78,145,146,172] |
| | Robotically present real objects for manipulation | [4,5] | ... |

| **Embodied Coaching Strategies** | Mobile robot gives instructions based on monitored movement | [3] |