

Control strategies for robot-assisted therapy			Examples for upper extremity	Examples for lower extremity
Assistance Strategies		Position control	[17,18,20–22,24,25,34,45,51–70]	[8–12,15,28,31,71–75,111,112]
	Impedance-based	channel	[17,18,56,80–82]	[9]
• Make task safer to allow practice		Velocity-field channel	[71]	[77]
• Enhance somatosensory input in a way correlated with motor output		Moving back wall	[45,50,55]	[71]
		Time/force/error-based trigger	[24,27,38,45,55,56,77,79,83–86]	[9]
• Increase task success to motivate practice		Passive gravity counterbalancing	[17,33,88,89]	[32,90,91]
	Counterbalance-based	Active weight compensation	[18,92–94]	[14,29,95]
• Provide appropriate challenge point for optimal learning		Counterpoise control	[23,96]	...
• Reinforce normative sensory-motor pathways	EMG-based	EMG-triggered impedance force proportional to EMG	[19,25,55,87] [97–99]	... [30,100,101]
• Interleave effort, which stimulates neuroplasticity, with stretching, which reduces soft tissue and reflex stiffness		Modulate stiffness	[55,94]	[10,105,107]
		Modulate desired movement time	[55]	[7,103,104]
		Modulate desired movement path	[50]	[10]
	Performance-based adaptive assistance	Modulate assistance force	[46]	...
		Learn static model of weakness	[50]	...
• Allow more repetitions, since participant completes movements more efficiently		Learn time-based model of forces	[110]	...
		Adjust unstable force field gain	[102]	...
		Minimize sum of error and effort	...	[6]
Challenge-Based Strategies	Resistance	Constant resistance	[33,58–60,81,108,123–126,163]	[73,120,121]
		Viscous resistance	[45]	[127]
• Increase neural and muscle plasticity by increasing activation and force		Cancel gravity only as needed	[50,92–94,128]	[9]
• Discourage abnormal movements or disuse of impaired limb	Constraint-induced	Resist asymmetric movements	...	[131]
		Resist movement of unimpaired arm	[130]	...
		Halt movement if off-axis forces are large	[96,102,113]	...
• Drive learning with larger errors		Increase kinematic error	[133]	[132]
	Error-amplification	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]
Make practice more flexible, convenient, safe, and motivating	Robotically present real objects for manipulation		[4,5]	...
Embodied Coaching Strategies	Mobile robot gives instructions based on monitored movement			[3]
Motivate practice with an embodied coach				