RBF-Based Adaptive Control Concept for a 6-DOF Flexible Manipulator: A Simulation Study on Precision and Energy Efficiency

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Modern lightweight manipulators suffer from flexibility-induced resonant oscillations[1,2,3]. This paper proposes an RBF-based Adaptive PD control architecture for a theoretical 6-DOF flexible-link manipulator modeled with a 0.55 Hz dominant resonance. To suppress vibrations, an RBF neural network dynamically adjusts baseline PD gains in real-time using pure online Lyapunov-based learning. Verified entirely within a rigorous sampled-data simulation framework, the proposed method improves trajectory tracking precision by 72.5% (RMS error reduction) over a classical PD controller. Crucially, proactive vibration damping reduces total mechanical energy consumption by over 25%.

References

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