Boosting Learning Efficiency for Tuning a Powered Knee Prosthesis: Offline-Online Policy Iteration

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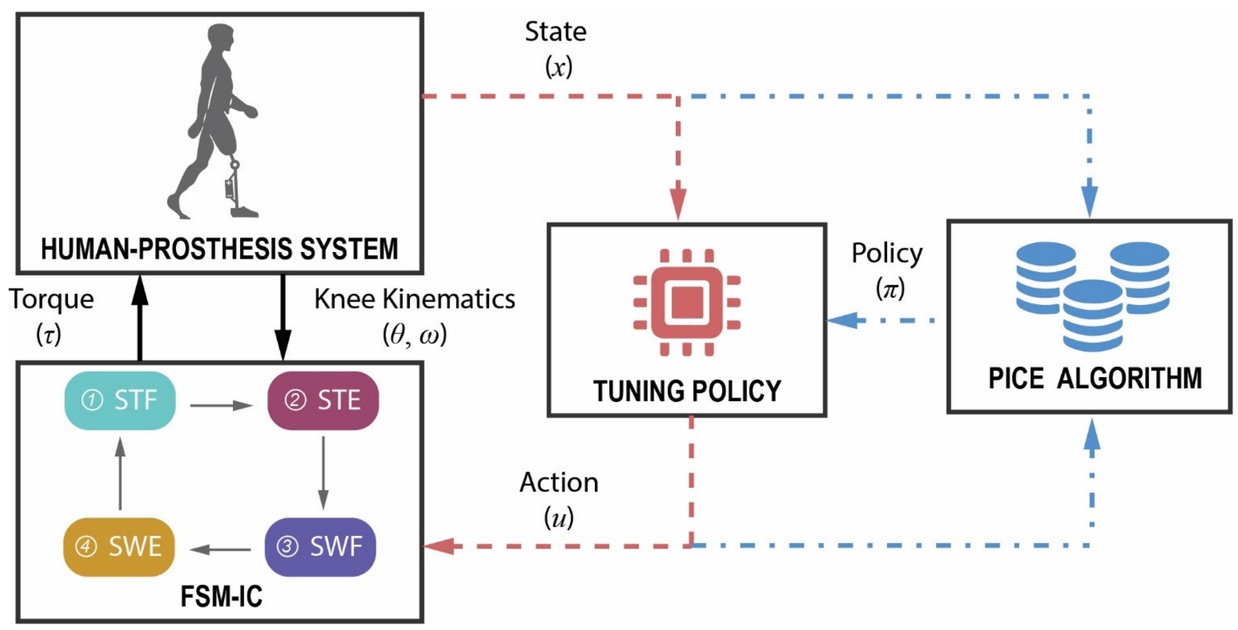
MOTIVATIONS

- Robotic knee prosthesis requires **customization of high-dimensional control parameters** for each user.
- Manually configuring these parameters is **time and labor intensive**.
- Existing proposed solutions for personalized prosthesis control are either **not reliable** or **dependent on knowledge of prosthetists**.
- Reinforcement learning is promising for auto-tuning prosthesis control[1]; however **data efficiency and time efficiency** are still needed for this application.

OBJECTIVES

- Develop an **offline-online policy iteration** based reinforcement learning algorithm
- Validate its feasibility to obtain a policy for **auto-tuning** high-dimensional prosthesis control to achieve **normative knee kinematics**.

METHOD



CONCLUSIONS

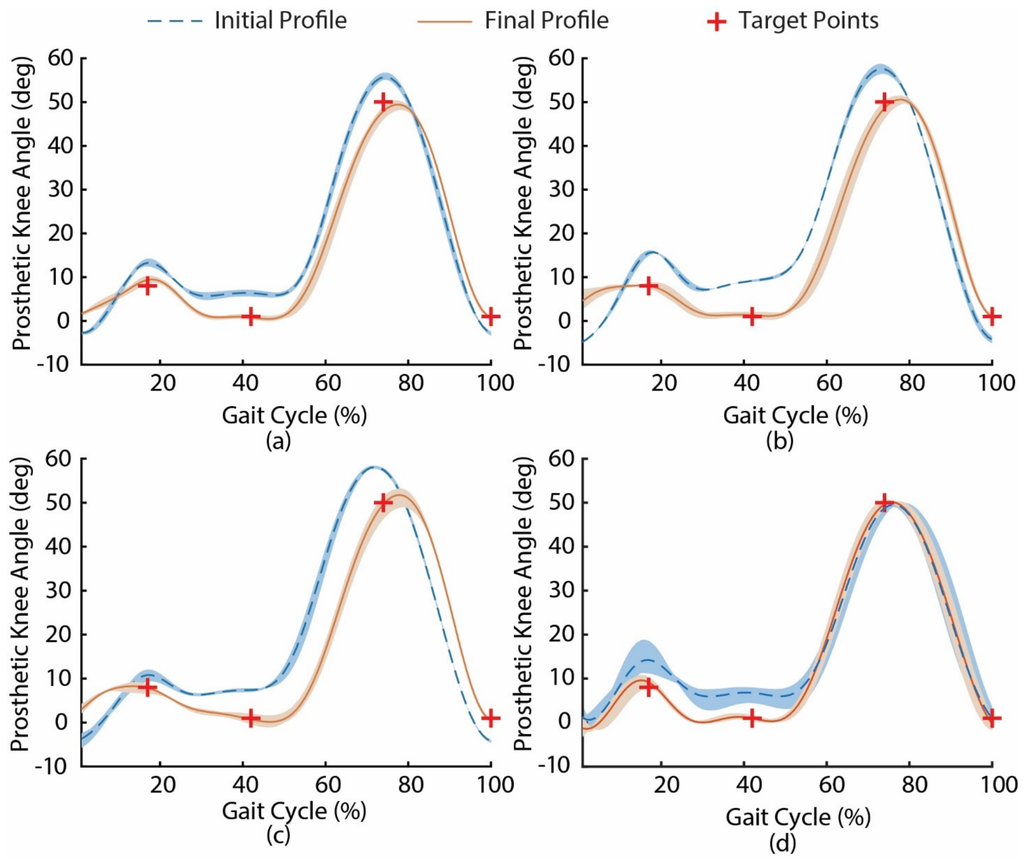
- The offline-online policy iteration based RL controller was **a promising new tool to solve the challenge in tuning** the robotic knee prosthesis control with human in the loop.
- The proposed approach was **data efficient and time efficient**, making its **clinical application possible**.

FUTURE WORK

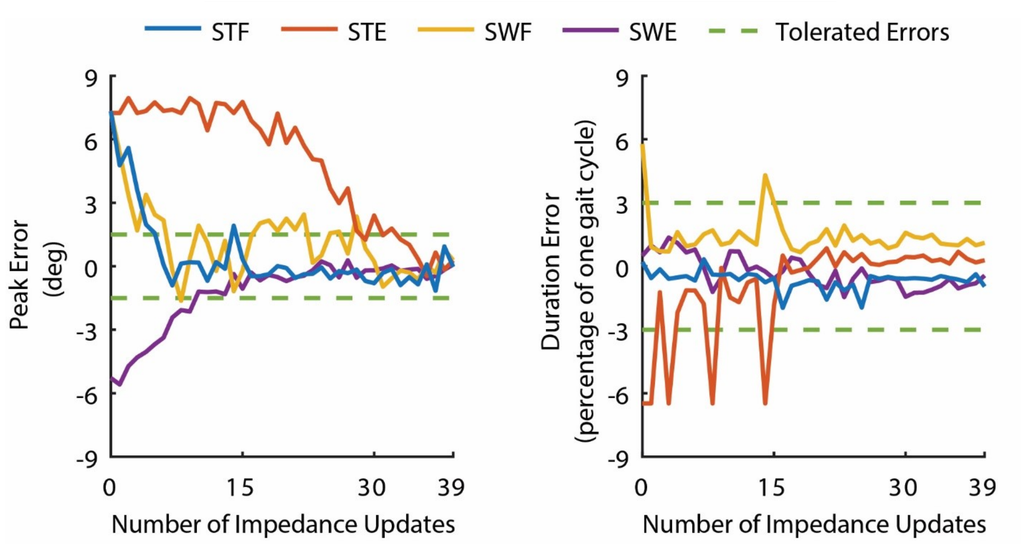
- Systematically test the approach on **more human subjects**.
- Investigate the feasibility to generalize the proposed method to **other assistive wearable** machines.

RESULTS

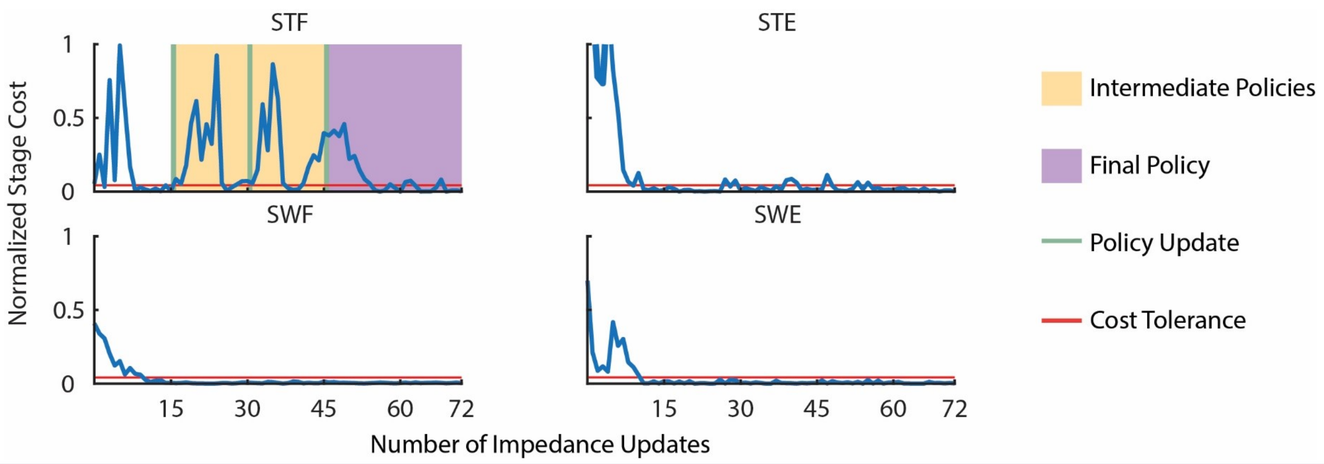
Knee Profile Comparison



Convergent Errors



Investigation of Learning Transfer



REFERENCES

[1] Y. Wen, et al., "Online Reinforcement Learning Control for the Personalization of a Robotic Knee Prosthesis," IEEE Transactions on Cybernetics, 2019.

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