**Variable Impedance as Control Scheme for Enhanced Performance and Stability of Active Ankle Foot Orthosis**

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**Research question:** Can variable damping control improve stability and agility of Ankle Foot Orthosis (AFO) and reduce muscle activation?

**Introduction:** The control technique of Active AFO can influence regular walking characteristics of subjects wearing them. Conventional techniques either provide agility and compromise stability or vice versa. This research introduces a novel user tailored Variable Damping Controller (VDC) that is exploits the agility-stability tradeoff and retains benefits of both.

**Method:** The governing equations of VDC are influenced by user intent that is a product of ankle velocity and acceleration.

\[
 b_p = \begin{cases} 
 2b_0 - b_0 & x > 0 \\
 -(2b_0 + b_0) & x < 0 
\end{cases} \quad \dot{x} \geq 0
\]

\[
 k_p = -\frac{\ln \left( \frac{x^\alpha}{x^\alpha} \right)}{b_0} \quad k_n = -\frac{\ln \left( \frac{x^\alpha}{x^\alpha} \right)}{b_0}
\]

Where \( b \) is instantaneous variable damping and \( k \) is a factor that controls rate of change of damping within the upper and lower bounds.

**Results:** A study on effect of various damping schemes on ankle during gait cycle and corresponding torques provided was conducted.

**Conclusion**

- VDC is more agile than positive damping and more stable than negative damping.
- The torque output of robot is promising and expected to reduce Tibialis Anterior muscle activation.

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**References**