

Performance Evaluation of the Biped Unit of LARMbot V.3

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INTRODUCTION & AIM

LARMbot V.3 adopts a modular biped unit with a parallel 3-UPR design.

Aim:

- experimental evaluation of the biped unit;
- analysis of kinematics and power consumption;
- comparison of suspended and ground walking.

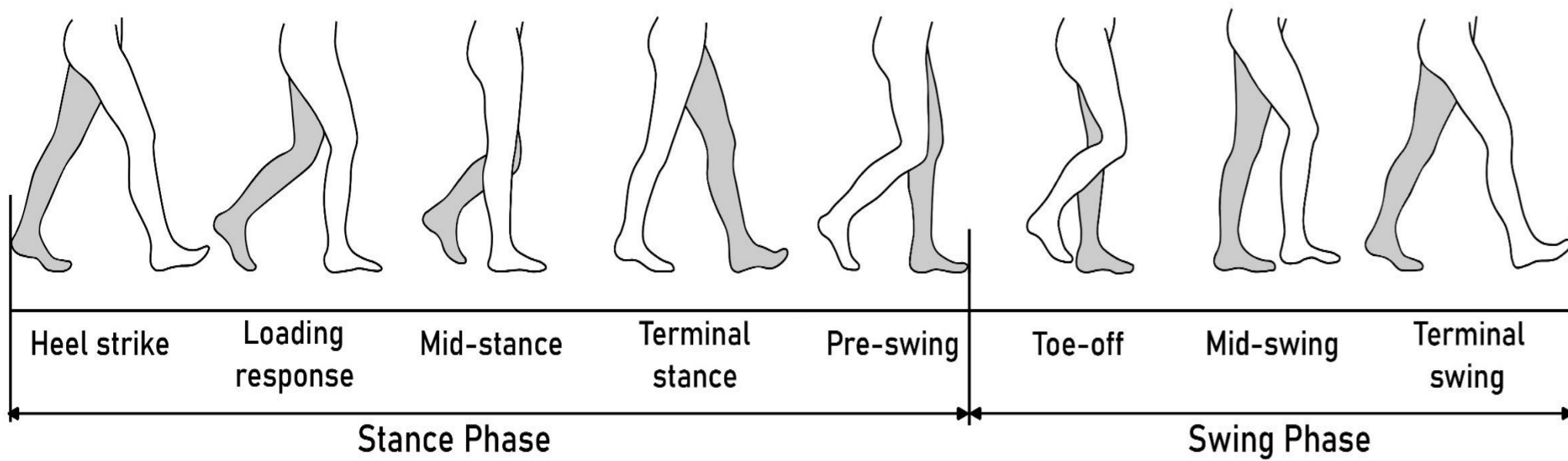


Figure 1. Phases of the normal human gait cycle

METHOD

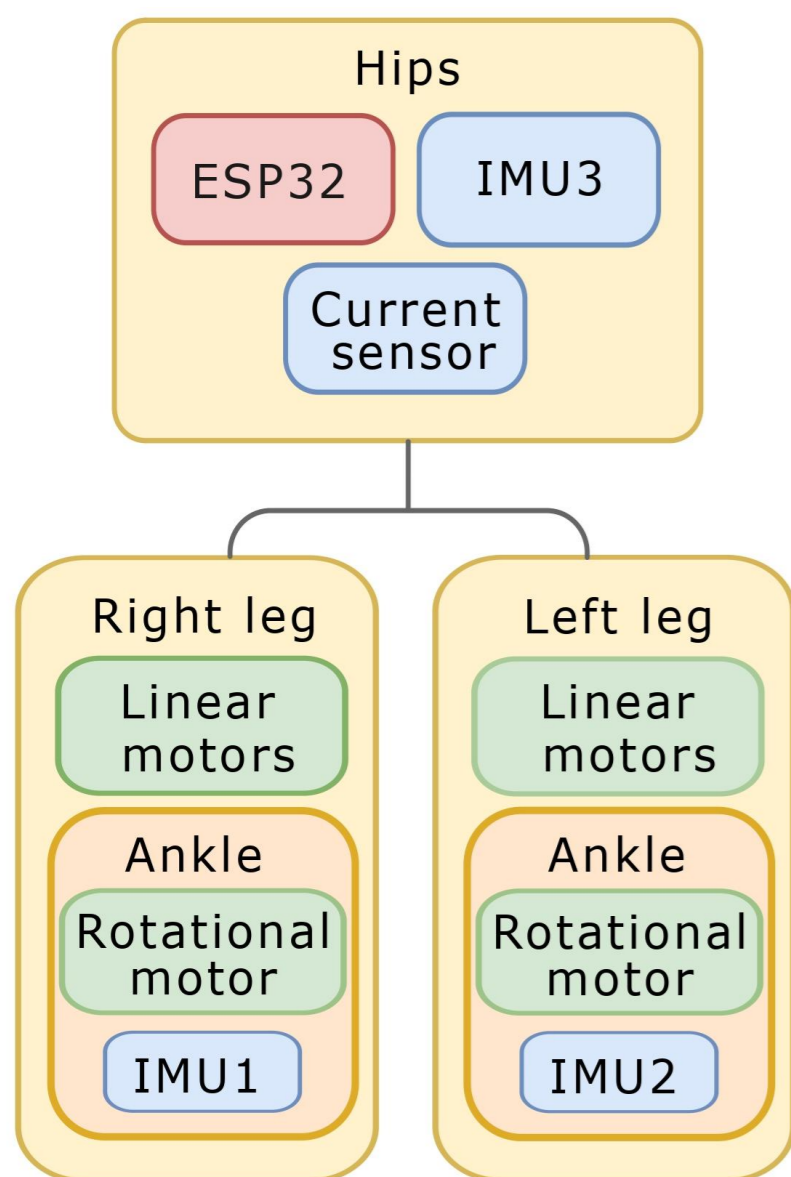


Figure 3. Conceptual design with components of LARMbot V.3 biped unit.

Actuation and sensing (Fig. 2)

- Six linear actuators and two ankle motors;
- Three IMUs and one current sensor.

Mechanical design (Fig. 3 (a))

- Modular biped unit.
- 3-UPR parallel mechanism

Kinematics (Fig. 3 (b))

Inverse kinematics

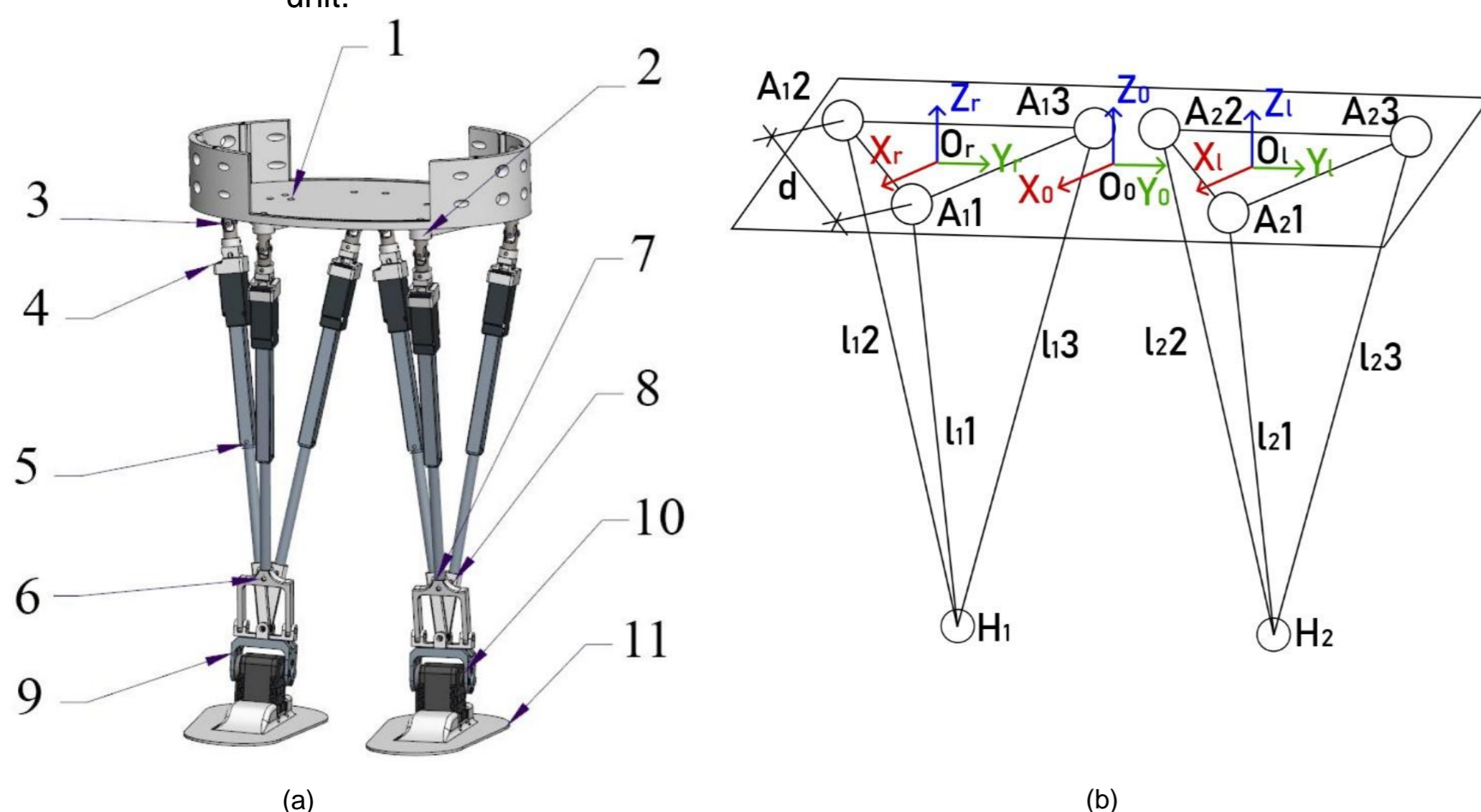


Figure 2. LARMbot V.3 biped unit: (a) Mechanical structure with labeled components; (b) Kinematic functional scheme with design parameters.

RESULTS & DISCUSSION

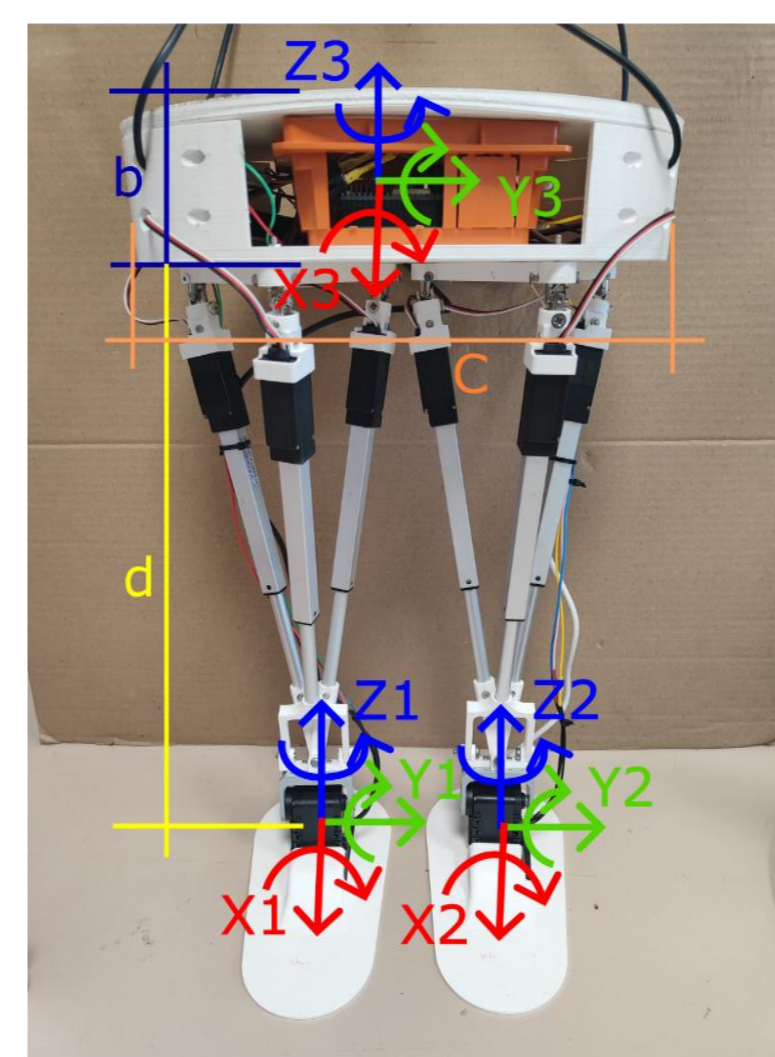


Figure 4. Prototype of the LARMbot V.3 biped unit with reference frames.

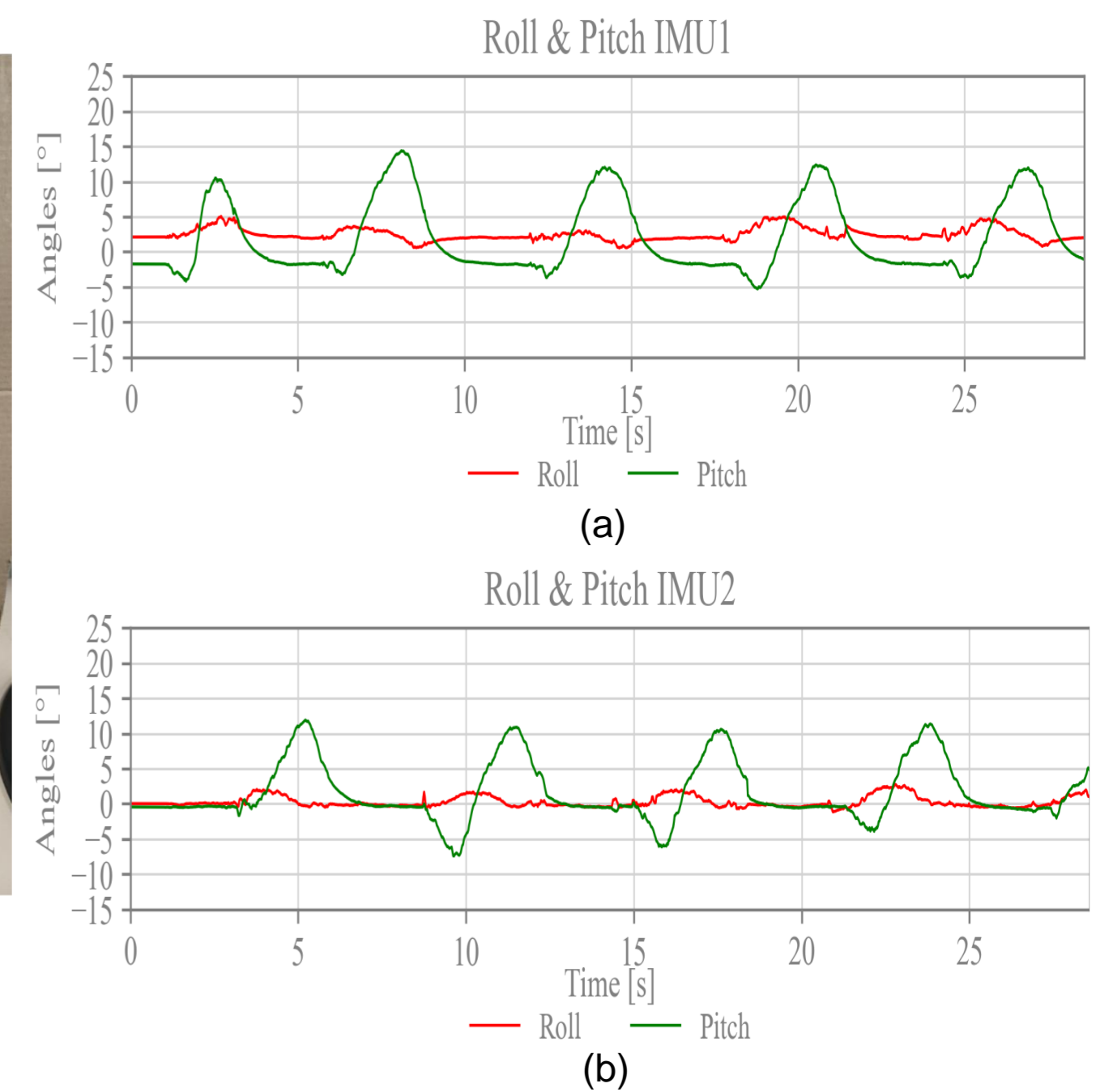


Figure 5. Acquired data for test in ground walking mode in terms of the roll and pitch angles for (a) right foot; (b) left foot;

Power consumption

- Suspended mode: average ≈ 9.6 W, peak ≤ 15 W;
- Ground walking: average ≈ 17.5 W, peak ≤ 23.8 W

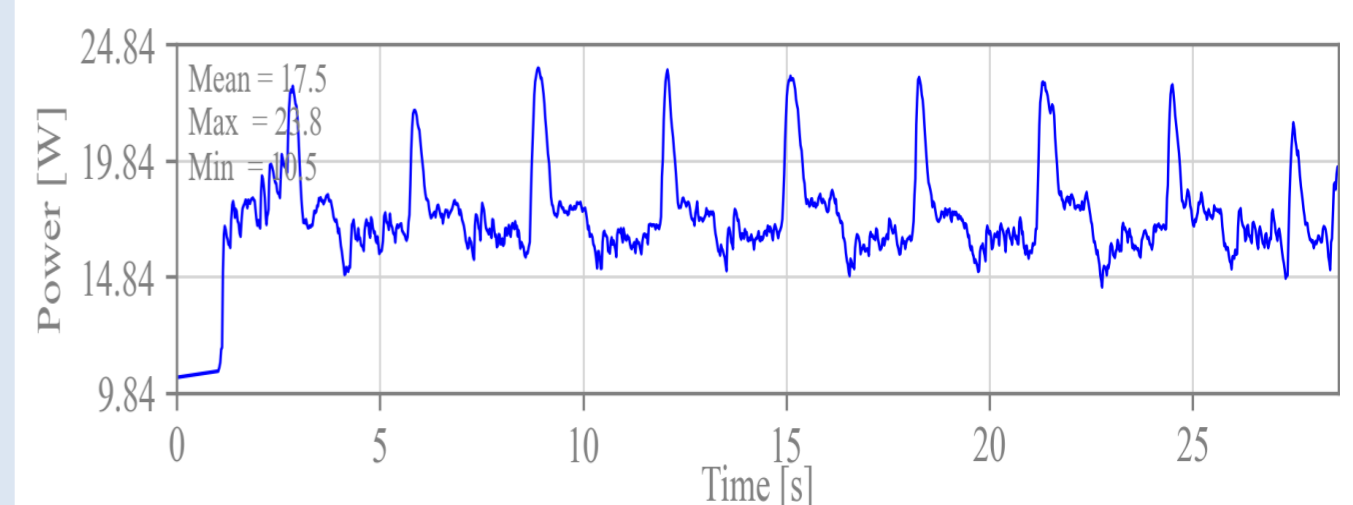


Figure 6. Acquired data for test in ground walking mode in terms of power consumption.

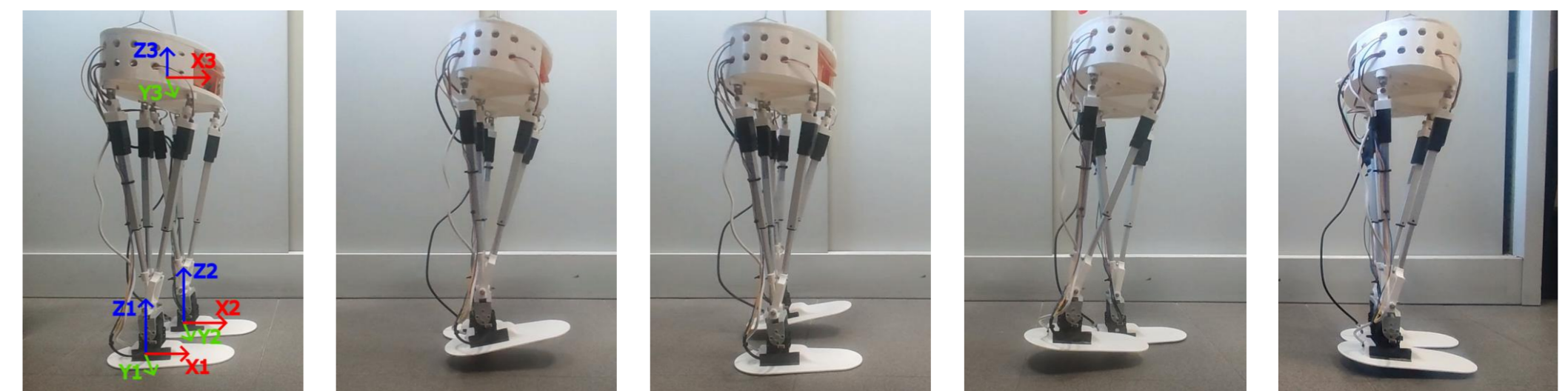


Figure 7. Snapshot of a test in ground walking mode.

CONCLUSION

A modular parallel-leg biped unit was designed and experimentally validated, demonstrating repeatable walking, stable kinematics, and acceptable power consumption.

FUTURE WORK / REFERENCES

Future work will focus on extending the sensor set and implementing closed-loop feedback control to improve autonomy and walking stability.