

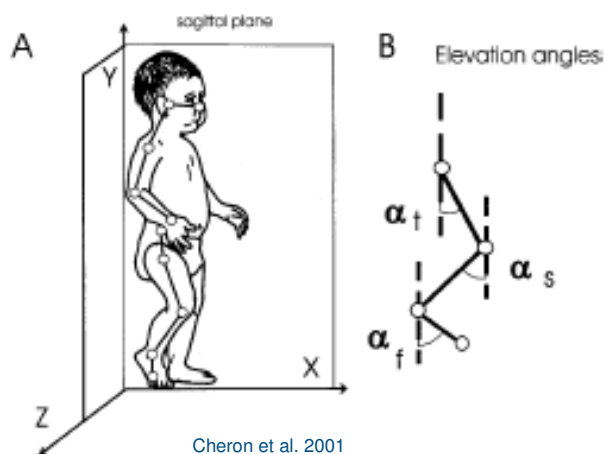


Planar covariation of elevation angles in
prosthetic gait.

Françoise Leurs
Guy Cheron

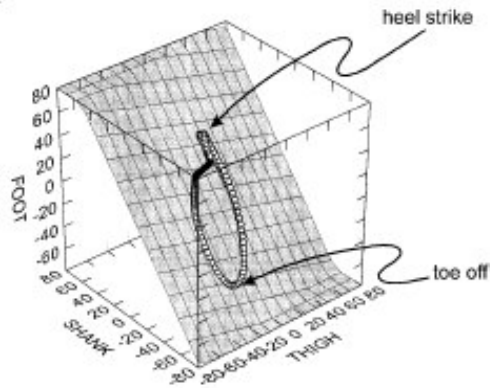
ULB

Introduction: Elevation angles



Cheron et al. 2001

Introduction: Planar covariation

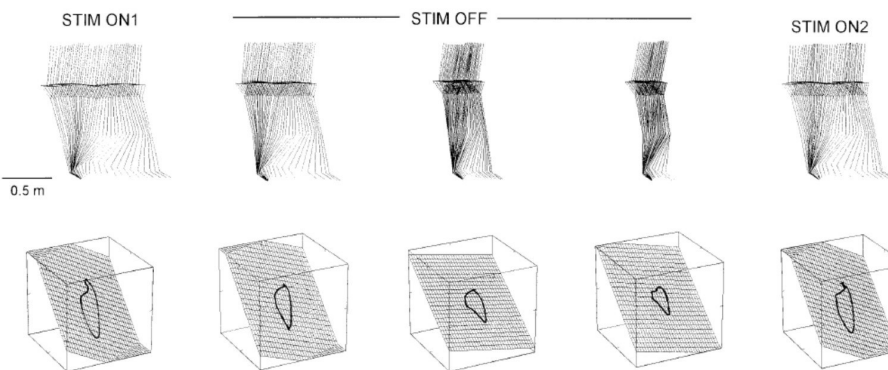


Cheron et al. 2001

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Introduction : Planar covariation in Parkinson's disease

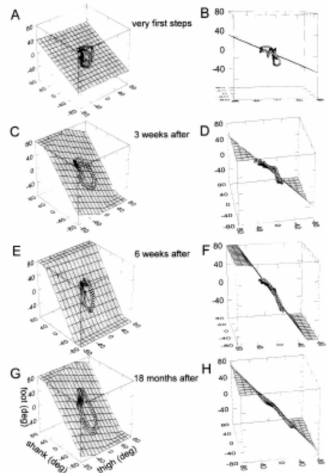


Grasso et al. 1999

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Introduction: Planar covariation in toddlers



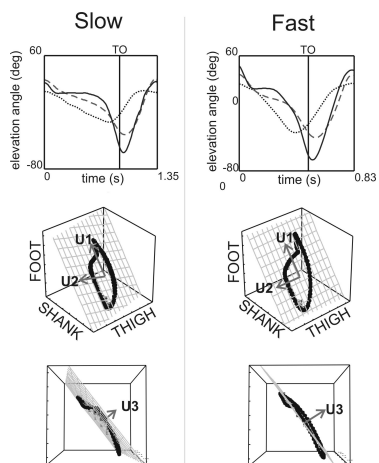
Cheron et al. 2001



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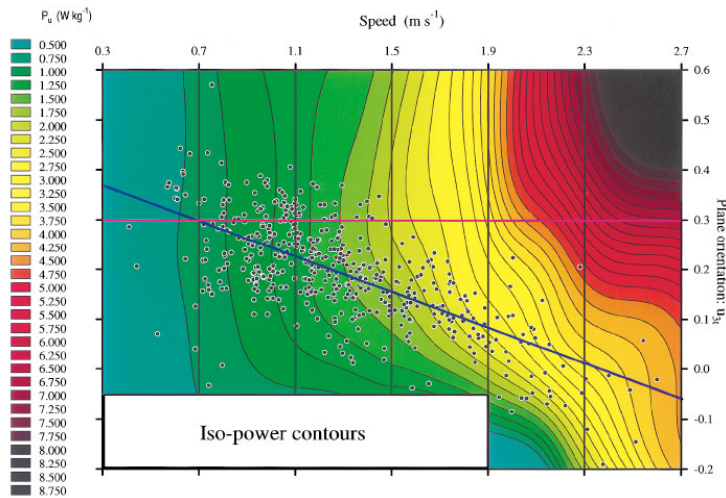
Introduction: Second « law » of planar covariation



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Introduction: Second « law » of planar covariation



Bianchi et al. 1998

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Aims of the thesis



- Does the first law of planar covariation exist in prosthetic gait, even in the « first prosthetic steps »?
- Does the second law of planar covariation exist in prosthetic gait?
- Is the coordination between the three segments of the sound limb different from control gait?
- What about the phase relationship between segments in prosthetic gait?

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- Population: total of 17 subjects:
 - 4 « expert » trans-femoral amputees,
 - 3 « novice » transfemoral amputees
 - 10 control subjects
- Procedures:
 - No indication of speed or cadence for overground walking
 - Training session for treadmill walking
 - Self-selected speed levels for amputees
 - Matched speed for controls plus maximal speed

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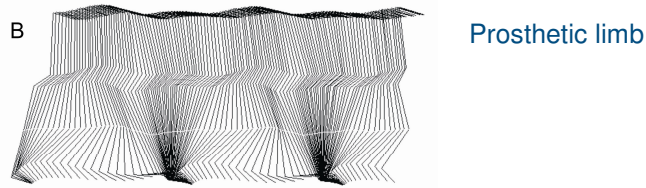
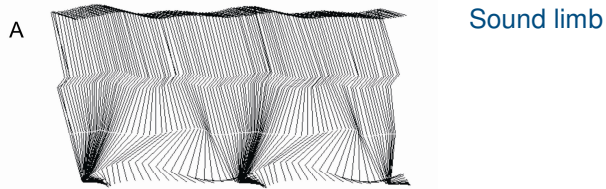


- Kinematics acquired by ELITE system (BTS Italy)
- Heel strike, Toe Off and Cycle duration determination
- Elevation angles computed and filtered with « Smart Analyser » software
- Principal component analysis and Fourier decomposition of elevation angles performed with « Statistica » software

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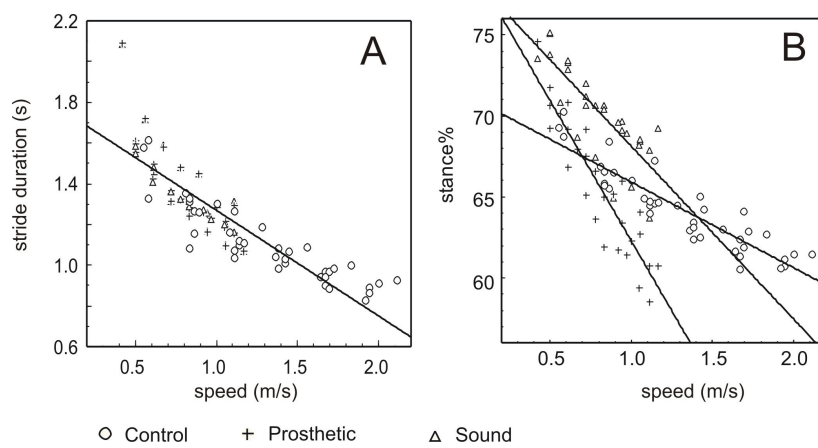
Results: Stick diagrams



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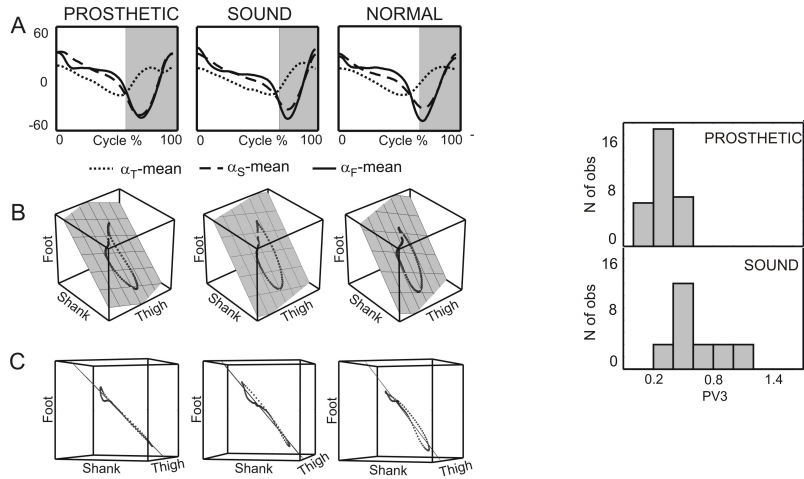
Results: Spatio-temporal parameters



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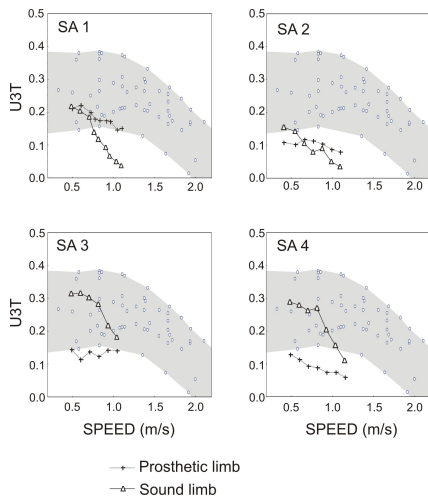
Results: First law of planar covariation



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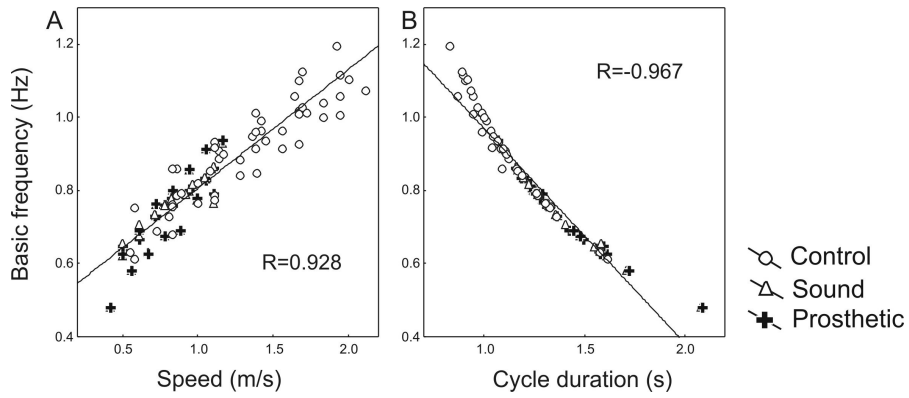
Results: Second law of planar covariation



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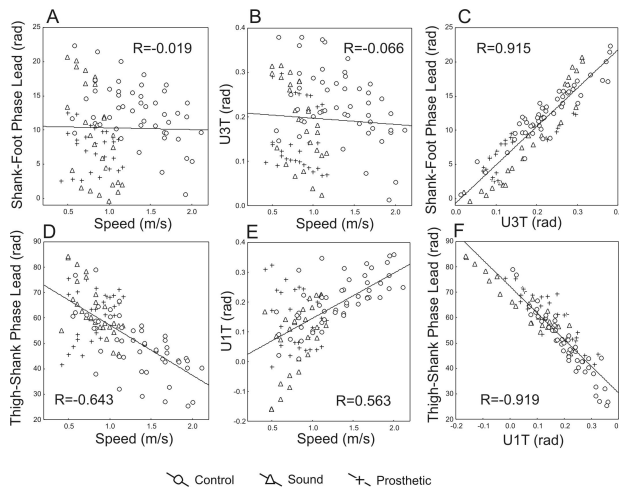
Results: Basic frequency of the first harmonic of elevation angles



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Results: Plane rotation and phase shift between elevation angles of different segments



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Conclusions:



- The first law of intersegmental coordination exists both in the sound and posthetic limb of transfemoral amputees.
- An identical basic frequency of the first harmonic of the thigh, shank and foot is the reason for planarity, like in control subjects.
- The second law of intersegmental coordination does not exist for mechanically passive prosthetic designs, but plane rotation is faster and more important with speed for the sound limb.
- A progressive phase shift between shank and foot elevation angles explains plane rotation, just as in control subjects.

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Conclusions:



- The tested intelligent knee joint could efficiently simulate the speed adaptations by phase shifts, shown by control subjects.
- Analysing the progressive phase shifts between thigh-shank and shank-foot elevation angles of both limbs could be an interesting and easy way for assessing biomechanical efficiency of prosthetic devices.

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Thank You

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