Supplementary information

Tinamou surgical details

General anaesthesia was induced with 22 mg/kg of ketamine (Ketamidor, Chanelle UK) and 0.075 mg/kg of medetomidine (Sedastart, Animalcare UK) administered intramuscularly in the right pectoral muscle. Once the anaesthetic induction was achieved, Tinamous were intubated with the use of an uncuffed endotracheal tube and surgical anaesthesia was then maintained with sevoflurane in oxygen. Hypothermia was limited with the use of active warming by either HotDog® or Bair Hugger® as per the crocodile surgeries. Five incisions 1-2cm long were made over the right ilium, caudal thigh, cranial thigh, caudal and cranial aspects of the lateral shank to enable visualisation and intramuscular implantation for the four implants. These incisions targeted, respectively (after the iliac incision), M. iliofibularis, M. iliotibialis cranialis, M. gastrocnemius pars lateralis, and M. tibialis cranialis. Some of the channels provided no data, and after experiments were completed and the birds were euthanised, some different muscles had been implanted, thus we focus on the muscles for which data were successfully collected: M. gastrocnemius pars lateralis and M. fibularis longus.

As with the crocodiles, the electrodes had been constructed of two strands of 0.004 inch diameter platinum pure TC grade insulated by heavy poly-nylon except soldered to a 26 pin IDC socket (625-7404 RS PRO). The IDC socket was attached to microporous surgical tape to create a backpack, through which the electrodes passed through a protective silicon tubing to the ventral aspect. A very similar method to the crocodiles was followed from here on. The free ends of electrodes were exposed and staggered. The electrode pairs were then tunnelled from the iliac incision to their respective insertion sites, with the shank implants being tunnelled via the cranial thigh incision. The electrodes were implanted using sew-through method and secured with two simple-interrupted sutures. The excess wiring was pulled back through to the iliac incision and tucked into a special pouch in the backpack. A splash block with lidocaine 0.2% (B Braun, DE) was performed for each surgical incision site prior to its closure (using 2-3 sutures of 5-0 mersilk) . The ground electrode was then injected along the midline and sutured into place. Next, the backpack was secured with eight sutures. Atropine (Atrocare, Animalcare, UK; 0.02 mg/kg) was given intravenously in the birds that experienced intraoperative bradyarrhythmias and hypotension. Occasionally, self-limited ventricular tachyarrhytmias were observed after the use of atropine. Butorphanol (Alvegesic, Dechra, AT; 2 mg/kg) and meloxicam (0.2 mg/kg) were administered intravenously to provide analgesia in the intraoperative and immediate postoperative period. At the end of the procedure, 0.1mg/kg atipamezole (Sedastop, Animalcare, UK) was given intramuscularly in the pectoralis muscle to antagonise the previously administered medetomidine. Atipamezole was redosed after 20 minutes in the birds that experienced a slow recovery. The birds were then given six days to recover before any data were collected in their enclosures, where they had access to food and water *ad libitum*.

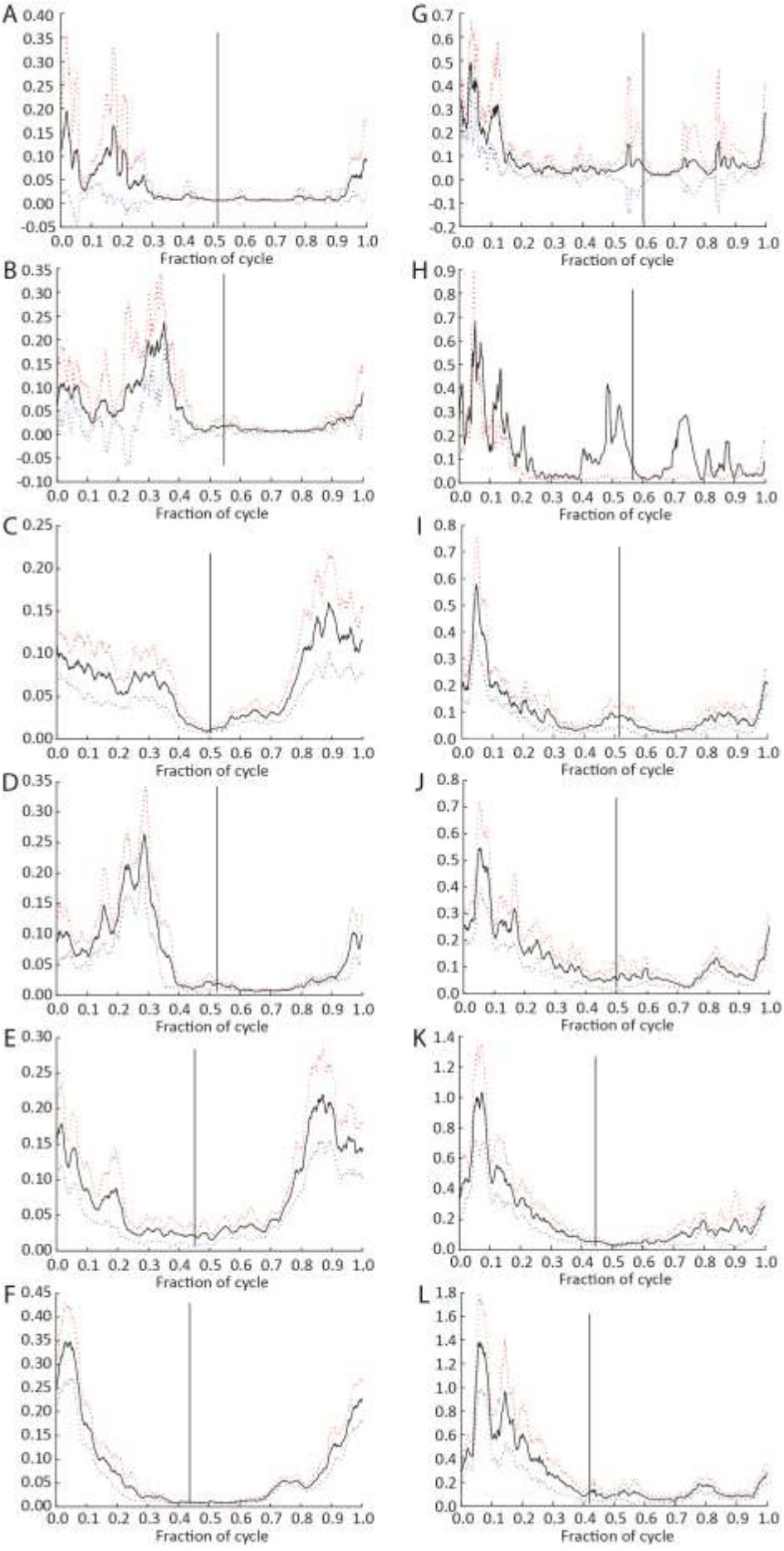


Figure S1. M. iliotrochantericus caudalis (ITC) average EMG signals across different speeds for emu babies and juveniles. A-F) Babies, G-L) juveniles. AG) = 0.3-0.5*u*, BH) = 0.5-0.7*u*, CI) = 0.7-0.9*u*, DJ) = 0.9-1.1*u*, EK) = 1.1-1.3*u*, FL) = 1.3-1.5*u.* Vertical lines are foot-off events as a fraction of an average stride cycle. Black = average, red and blue are upper and lower 95% confidence intervals. Y axis is recorded electrical signal after amplification, filtering and rectification, but due to different amplifications they are not comparable between the different ages.

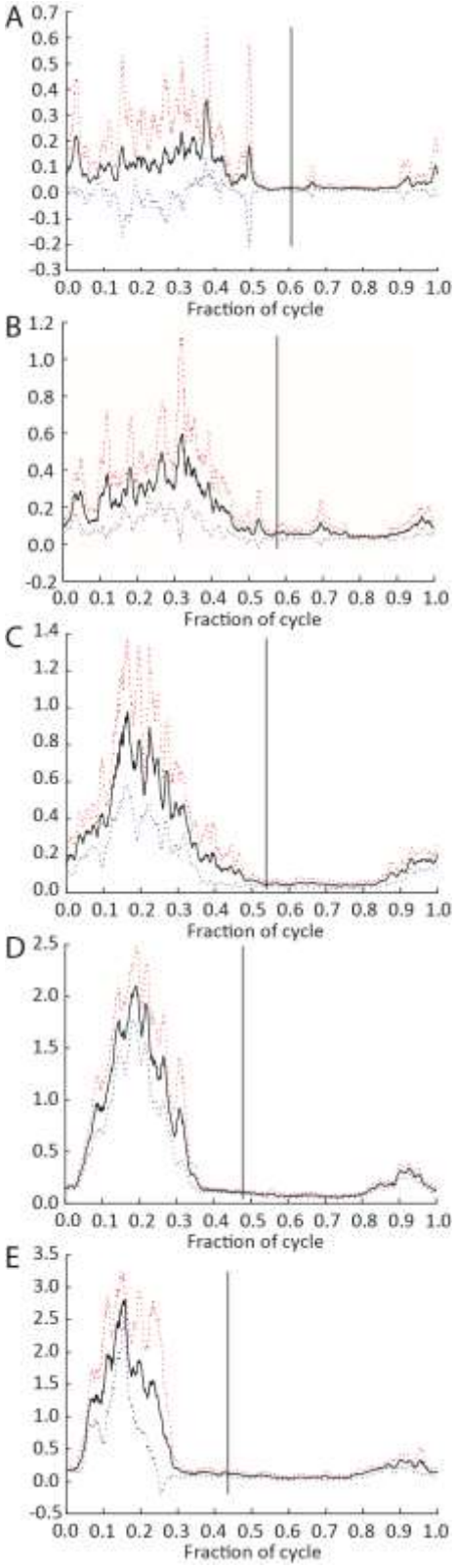


Figure S2. M. iliotibialis lateralis pars postacetabularis (ILPO) average EMG signals across different speeds for emu adults.

A) = 0.3-0.5*u*

B) = 0.5-0.7*u*

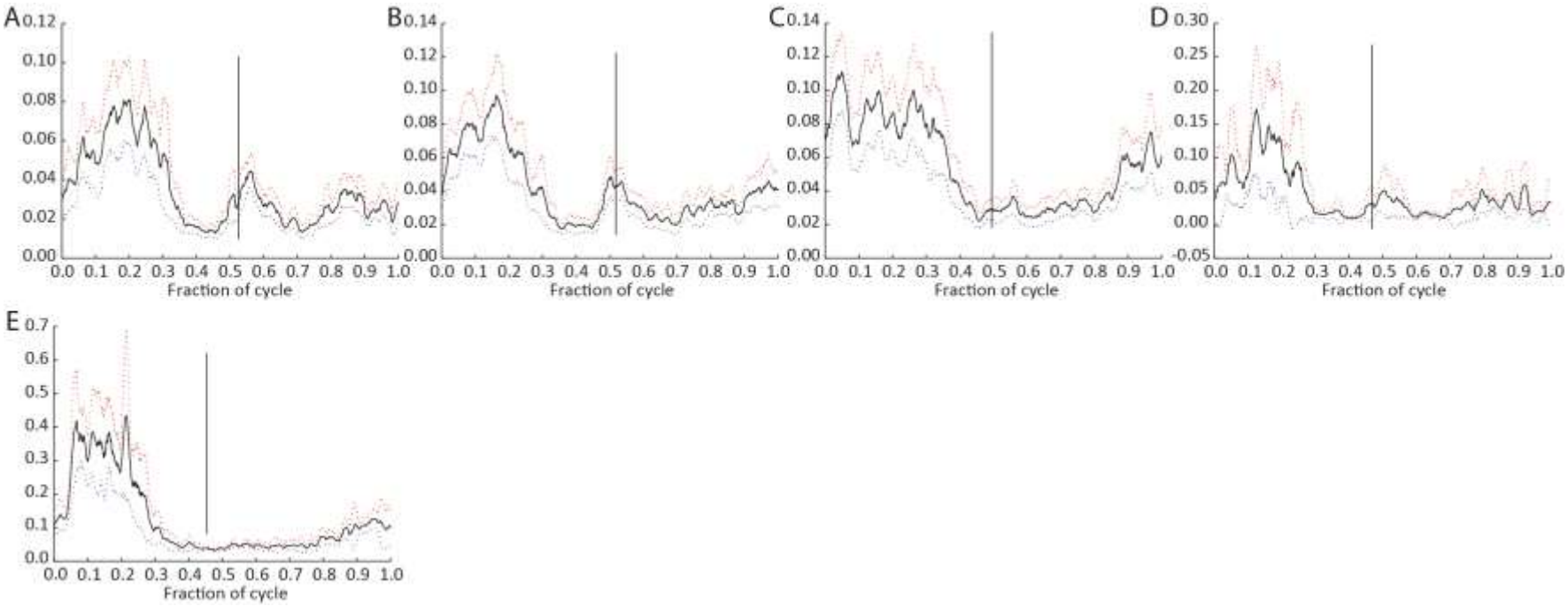
C) = 0.7-0.9*u*

D) = 0.9-1.1*u*

E) = 1.1-1.3*u*

Vertical lines are foot-off events as a fraction of an average stride cycle. Black = average, red and blue are upper and lower confidence intervals. Y axis is recorded electrical signal after amplification, filtering and rectification.

Figure S3. M. iliofibularis (ILFB) average EMG signals across different speeds for emu babies and juveniles. A)-D) babies, E) juveniles. A) = 0.7-0.9*u*, B) = 0.9-1.1*u*, C) and E) = 1.1-1.3*u*, D) = 1.3-1.5*u.*Vertical lines are foot-off events as a fraction of an average stride cycle. Black = average, red and blue are upper and lower confidence intervals. Y axis is recorded electrical signal after amplification, filtering and rectification but due to different amplification should not be compared between the different age groups.



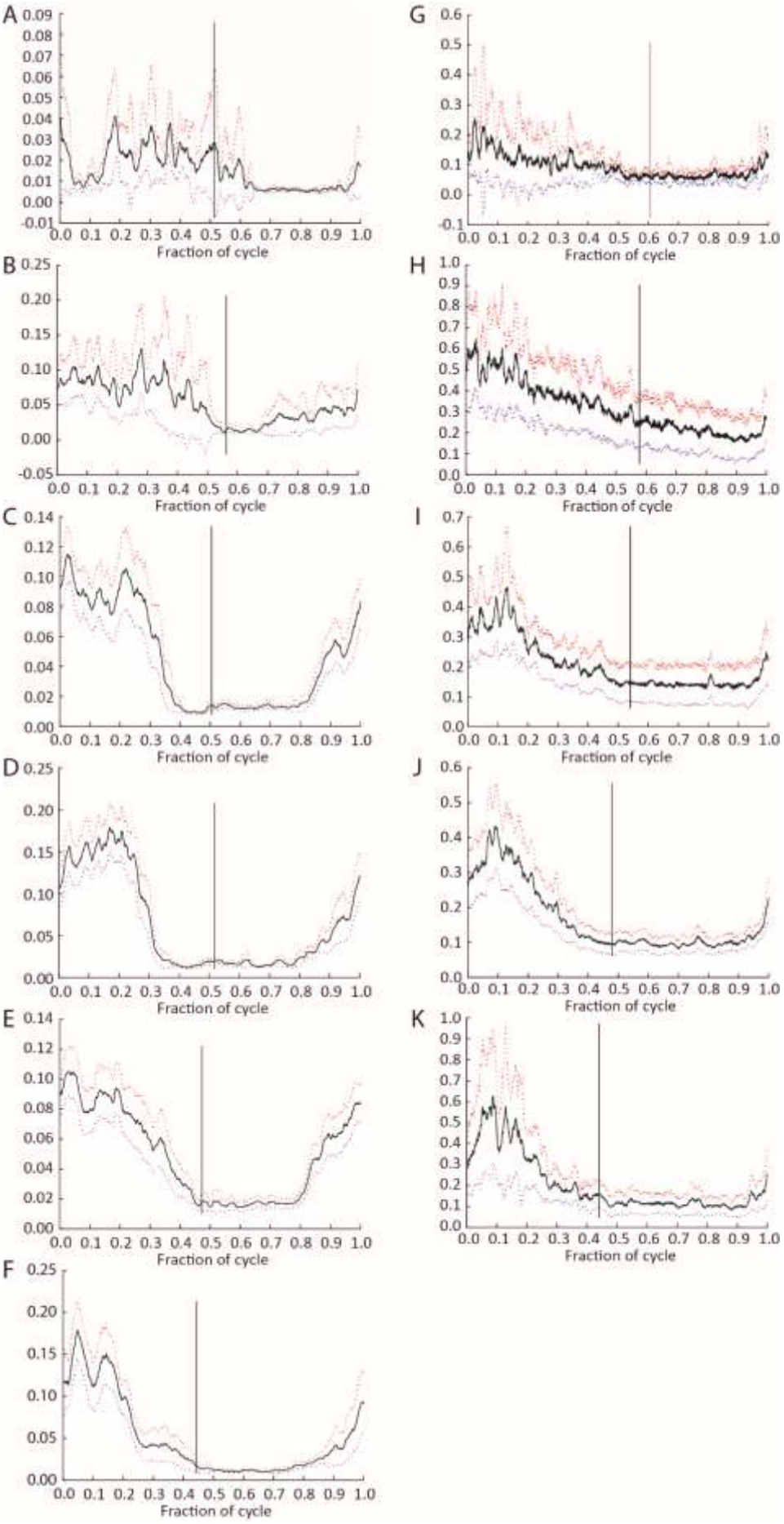


Figure S4. M. gastrocnemius pars lateralis (GL) average EMG signals across different speeds for emu babies and adults. A-F) Babies, G-K) Adult. AG) = 0.3-0.5*u*, BH) = 0.5-0.7*u*, CI) = 0.7-0.9*u*, DK) = 0.9-1.1*u*, EK) = 1.1-1.3*u*, F) = 1.3-1.5*u*. Vertical lines show the average duty factor of the trials. Black = average, red and blue are upper and lower confidence intervals. Y axis is recorded electrical signal after amplification, filtering and rectification, but due to different amplifications they are not comparable between the different ages.

Figure S5. Tinamou average EMG signals for A-C) M. gastrocnemius pars lateralis (GL), and D) M. fibularis longus (FL) muscles. A,D) *u* = 0.06, B) *u* = 0.23, C) *u* = 0.29. Vertical lines are foot-off events as a fraction of an average stride cycle. Black = average, red and blue are upper and lower 95% confidence intervals. Y axis is recorded electrical signal after amplification, filtering and rectification, but due to different amplifications they are not comparable between the different graphs.

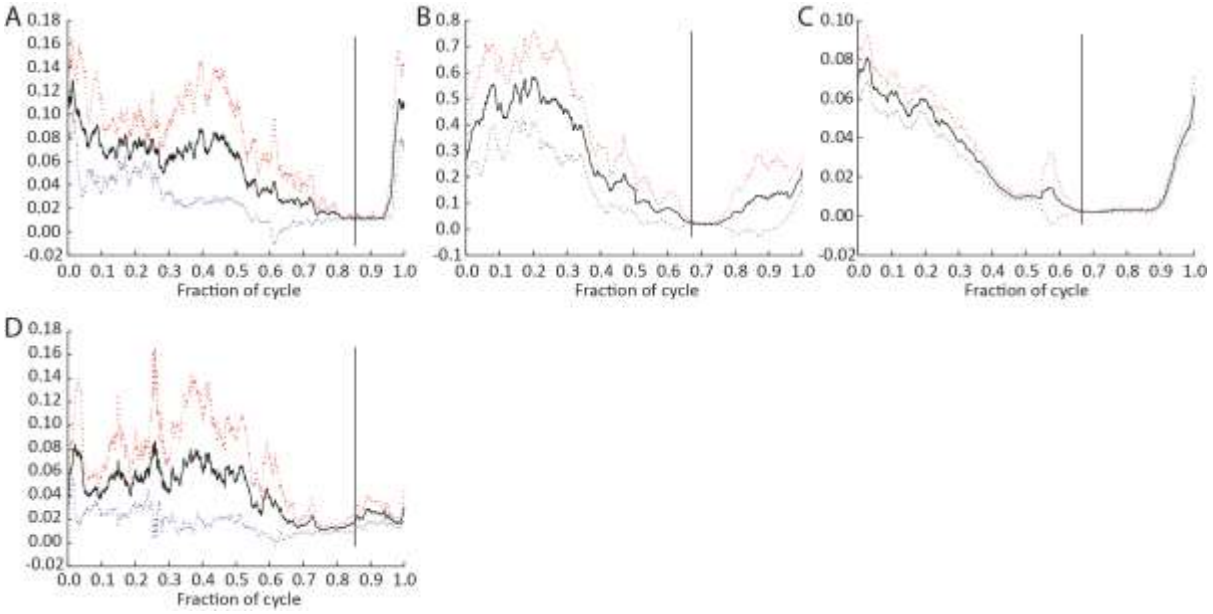


Figure S6. Turkey average EMG signals for A) M. flexor cruris lateralis pars pelvica (FCLP), B) M. gastrocnemius pars lateralis (GL) and C) M. flexor perforatus digiti IV (DFIV) muscles. Vertical lines are foot-off events as a fraction of an average stride cycle. Black = average, red and blue are upper and lower 95% confidence intervals. Y axis is recorded electrical signal after amplification, filtering and rectification, but due to different amplifications they are not comparable between the different muscles.

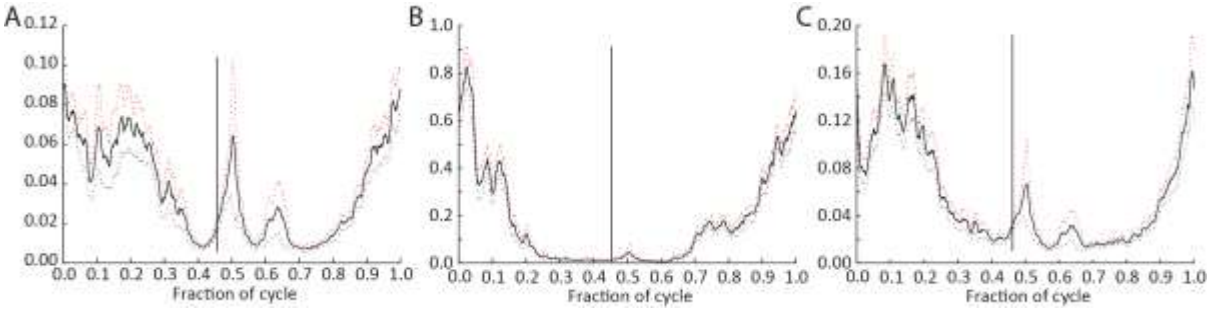


Figure S7. Guineafowl average EMG signals for A) M. femortibialis lateralis (FMTL), B) M. gastrocnemius pars lateralis (GL) and C) M. flexor perforatus digiti IV (DFIV) muscles. Vertical lines are foot-off events as a fraction of an average stride cycle. Black = average, red and blue are upper and lower 95% confidence intervals. Y axis is recorded electrical signal after amplification, filtering and rectification.

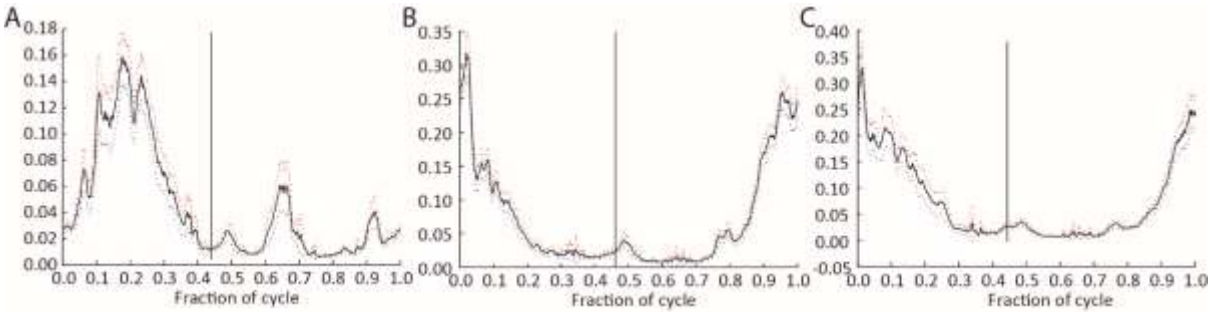
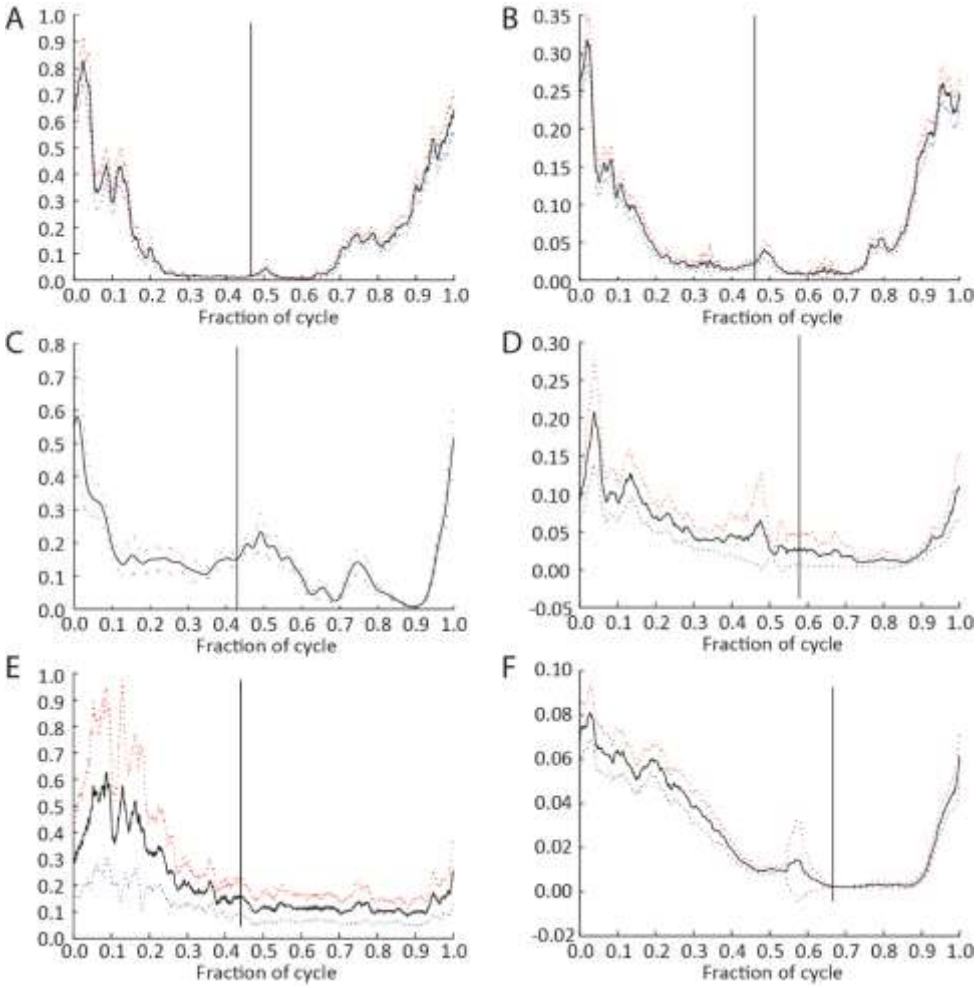


Figure S8. M. gastrocnemius pars lateralis (GL) across bird species at the same dimensionless speed (1.2). A) turkey, B) guineafowl, C) pheasant, D) quail, E) emu, F) tinamou. Vertical lines are foot-off events as a fraction of an average stride cycle. Black = average, red and blue are upper and lower 95% confidence intervals. Y axis is recorded electrical signal after amplification, filtering and rectification, but due to different amplifications are not directly comparable across species.



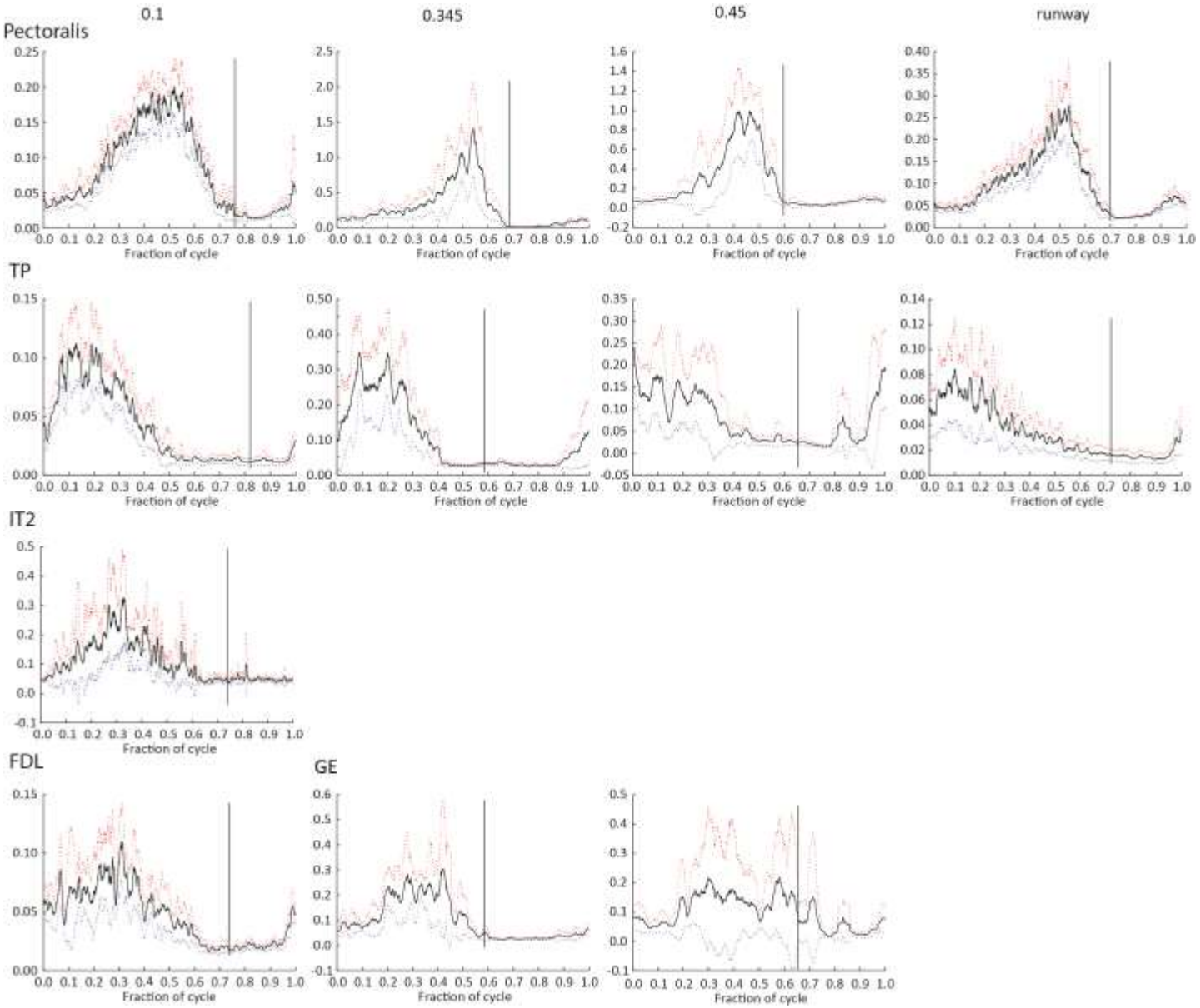


Figure S9. Crocodile EMG signals for the M. pectoralis (PEC), M. transversus perinei (TP), M. iliotibialis 2 (IT2), M. flexor digitorum longus (FDL) and M. gastrocnemius externus (GE) muscles. Columns relate to speeds, with all speeds in ms^{-1}. The runway corresponds to normal walking speed, which was about 0.1 ms^{-1}. Vertical lines show the average duty factor of the trials. Black = average, red and blue are upper and lower 95% confidence intervals. Y axis is recorded electrical signal after amplification, filtering and rectification