Electronic supplementary material

Muscle prestimulation tunes velocity preflex in simulated perturbed hopping

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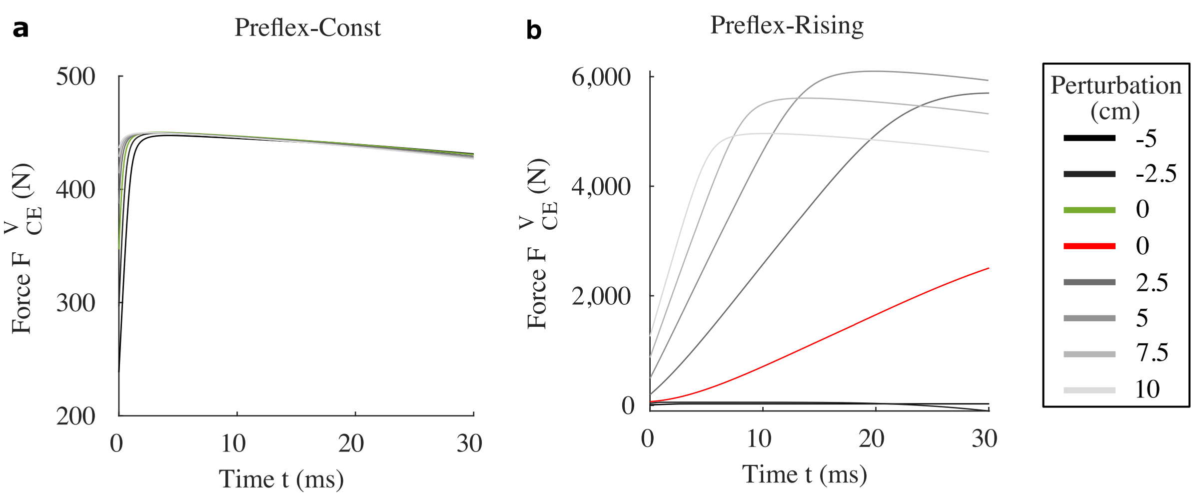

Fig. S1: Time trajectories of the force component produced by the force-velocity relation (F^{V}_{CE}). Data plotted from touch-down ($t = 0ms$) to the end of the preflex duration ($t = 30ms$). (a) Preflex-Const, with reference hopping case in green; (b) Preflex-Rising, with reference hopping case in red.

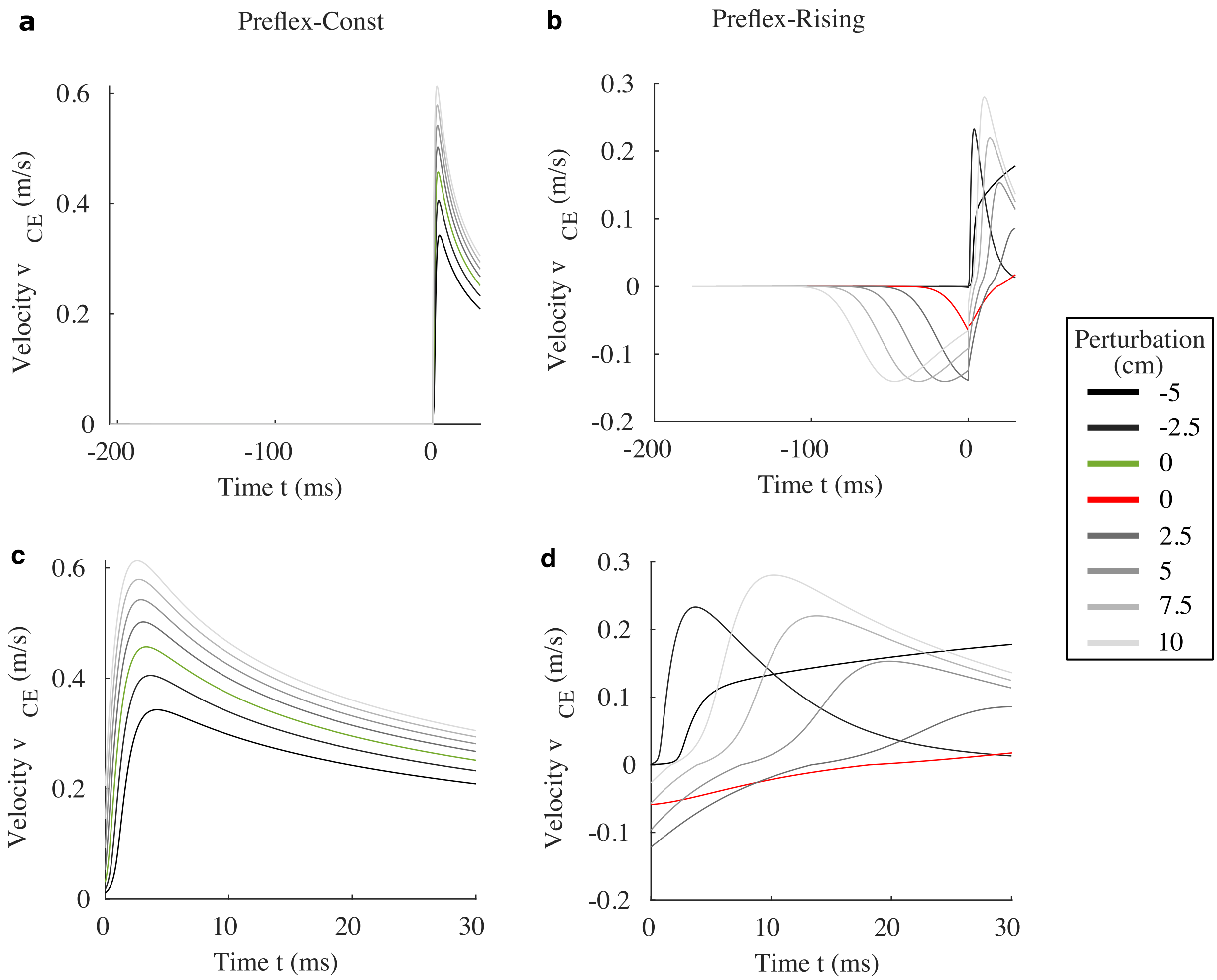

Fig. S2: (a,b) Time trajectories of the muscle fibre velocity (v_{CE}). Data plotted from the start of the leg's vertical fall to the end of the preflex duration ($t = 30ms$). All dataset are centered to the touch-down event ($t = 0ms$). (c,d) Close up (touch-down to preflex end) of the time trajectories of the muscle fibre velocity (v_{CE}). (a,c) Preflex-Const, with reference hopping case in green; (b,d) Preflex-Rising, with reference hopping case in red.

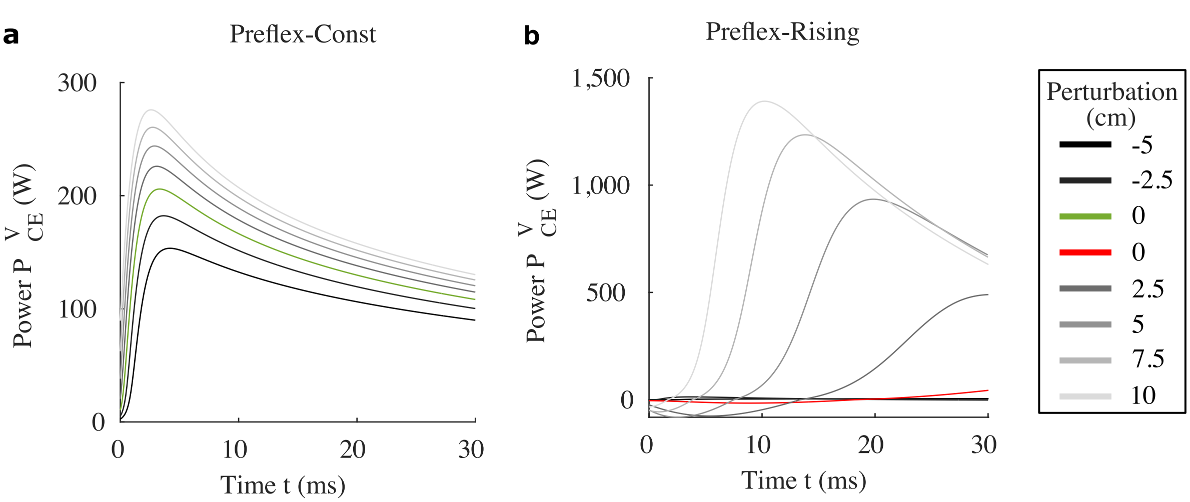

Fig. S3: Time trajectories of the muscle fibre power component produced by the force-velocity relation ($P^V_{CE} = F^V_{CE} \cdot v_{CE}$). Data plotted from touch-down ($t = 0ms$) to the end of the preflex duration ($t = 30ms$). (a) Preflex-Const, with reference hopping case in green; (b) Preflex-Rising, with reference hopping case in red.

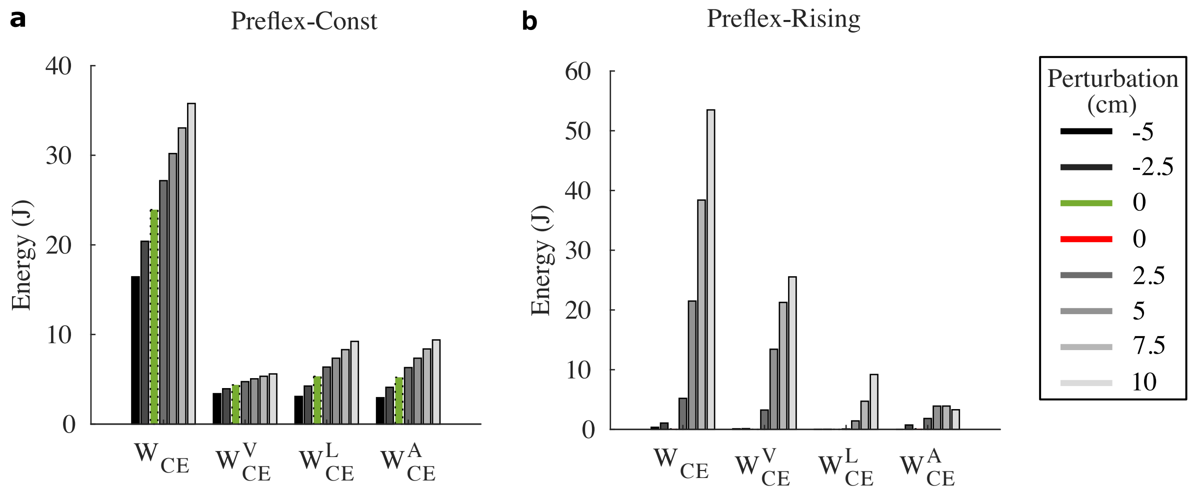

Fig. S4: Work dissipated by the muscle fibres during the preflex phase. W_{CE} is the net dissipated work; W_{CE}^{V} is the work component dissipated by the force-velocity relation, W_{CE}^{L} by the force-length relation, and W_{CE}^{A} by the muscle activity. (a) Preflex-Const, with reference hopping case in green; (b) Preflex-Rising, with reference hopping case in red.

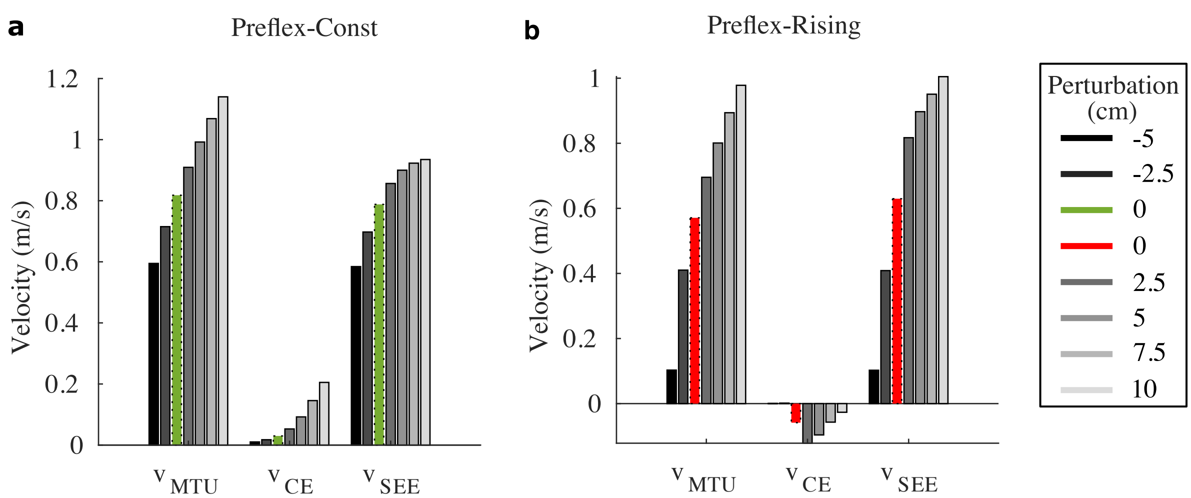

Fig. S5: Touch-down values of muscle-tendon unit velocity (v_{MTU}), muscle fibre velocity (v_{CE}) and tendon fibre velocity (v_{SEE}). (a) Preflex-Const, with reference hopping case in green; (b) Preflex-Rising, with reference hopping case in red.

TABLE S1: Table of supplementary parameters used in the muscle model and activation dynamics (Hatze).

	Parameter	Unit	Value	Source	Description
MTU	$l_{MTU,ref}$	m	0.5	Geyer et al. (2003)	muscle-tendon unit's reference length, alias l_{ref} in Geyer et al. (2003)
CE	ΔW^{des}	[ ]	0.45	similar to Bayer et al. (2017); Kistemaker et al. (2006)	width of normalized bell curve in descending branch, adapted to match observed force-length curves
	ΔW^{asc}	[ ]	0.45	similar to Bayer et al. (2017); Kistemaker et al. (2006)	width of normalized bell curve in ascending branch, adapted to match observed force-length curves
	$\nu_{CE,des}$	[ ]	1.5	Mörl et al. (2012)	exponent for descending branch of force-length relation
	$\nu_{CE,asc}$	[ ]	3.0	Mörl et al. (2012)	exponent for ascending branch of force-length relation
	$A_{rel,0}$	[ ]	0.2	Bayer et al. (2017)	parameter for contraction dynamics: maximum value of A_{rel}
	$B_{rel,0}$	1/s	2.0	Bayer et al. (2017)	parameter for contraction dynamics: maximum value of B_{rel}
	$\mathcal{S}_{ecc}$	[ ]	2.0	Soest and Bobbert (1993)	ratio of the derivatives of the force-velocity relation at the transition point ($v_{CE} = 0\,\mathrm{m/s}$)
	$\mathcal{F}_{ecc}$	[ ]	1.5	Soest and Bobbert (1993)	factor by which the force can exceed F_{isom} for large eccentric velocities
PEE	$\mathcal{L}_{PEE,0}$	[ ]	0.95	Bayer et al. (2017)	rest length of PEE normalized to optimal length of CE
	ν_{PEE}	[ ]	2.5	Mörl et al. (2012)	exponent of F_{PEE}
	$\mathcal{F}_{PEE}$	[ ]	2.0	Mörl et al. (2012)	force of PEE if l_{CE} is stretched to ΔW_{des}
SDE	D_{SDE}	[ ]	0.3	Mörl et al. (2012)	dimensionless factor to scale $d_{SDE,max}$
	R_{SDE}	[ ]	0.01	Mörl et al. (2012)	minimum value of d_{SDE} (at F_{MTU} = 0N), normalized to $d_{SDE,max}$
SEE	$l_{SEE,0}$	m	0.4	Geyer et al. (2003)	tendon's rest length, alias l_{rest} in Geyer et al. (2003)
	$\Delta U_{SEE,nll}$	[ ]	0.0425	Mörl et al. (2012)	relative stretch at non-linear linear transition
	$\Delta U_{SEE,l}$	[ ]	0.017	Mörl et al. (2012)	relative additional stretch in the linear part providing a force increase of $\Delta F_{SEE,0}$
	$\Delta F_{SEE,0}$	N	0.4 F_{max}	Bayer et al. (2017)	both force at the transition and force increase in the linear part
Hatze	m	1/s	11.3	Kistemaker et al. (2006)	inverse of time constant for the activation dynamics ($1/\tau$, τ defined in TABLE 1)
	c	mol/l	1.37e-4	Kistemaker et al. (2006)	constant for the activation dynamics
	μ	l/mol	5.27e4	Kistemaker et al. (2006)	constant for the activation dynamics
	k	[ ]	2.9	Kistemaker et al. (2006)	constant for the activation dynamics
	q_0	[ ]	0.005	Kistemaker et al. (2006)	resting active state for all activated muscle fibers
	ν	[ ]	3	Kistemaker et al. (2006)	constant for the activation dynamics

References

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