Legends for Supplementary Video Material

SMV1_50Nm. B-mode ultrasound video of 50 Nm isometric contraction in participant 5. ASM segmentation results are defined by the yellow x-markers connected by yellow line segments. Within each segment (superficial aponeurosis, fascicle region, deep aponeurosis) markers are coloured using a different palette, and show persisting KLT features (x-markers); newly acquired KLT features (circular markers with halos). The probes are coloured differently depending on whether they are being updated by: i) triangle-based linear interpolation; ii) nearest neighbour interpolation. For example, probes near the `corners' of the gastrocnemius segment tend to lie outside the KLT feature set's convex hull and are therefore moved using nearest neighbour interpolation. Neighbouring probes (that are under the control of the same interpolation method) are connected by line segments to give a visualisation of muscle deformation. Also note the opposite movement direction of rows in deep and superficial regions (See also Fig. 7b).

SMV2_20deg. B-mode ultrasound video of 20^{o} ankle joint rotation in participant 5. ASM segmentation results are defined by the yellow x-markers connected by yellow line segments. Within each segment (superficial aponeurosis, fascicle region, deep aponeurosis) markers are coloured using a different palette, and show persisting KLT features (x-markers); newly acquired KLT features (circular markers with halos). The probes are coloured differently depending on whether they are being updated by: i) triangle-based linear interpolation; ii) nearest neighbour interpolation. For example, probes near the `corners' of the gastrocnemius segment tend to lie outside the KLT feature set's convex hull and are therefore moved using nearest neighbour interpolation. Neighbouring probes (that are under the control of the same interpolation method) are connected by line segments to give a visualisation of muscle deformation. Also note how rows in deep and superficial regions move in the same direction, unlike in the 50 Nm condition (SMV1_50Nm, also see Fig. 7a)

SMV3_2deg. B-mode ultrasound video of 2^{o} ankle joint rotation in participant 5. ASM segmentation results are defined by the yellow x-markers connected by yellow line segments. Within each segment (superficial aponeurosis, fascicle region, deep aponeurosis) markers are coloured using a different palette, and show persisting KLT features (x-markers); newly acquired KLT features (circular markers with halos). The probes are coloured differently depending on whether they are being updated by: i) triangle-based linear interpolation; ii) nearest neighbour interpolation. For example, probes near the `corners' of the gastrocnemius

segment tend to lie outside the KLT feature set's convex hull and are therefore moved using nearest neighbour interpolation. Neighbouring probes (that are under the control of the same interpolation method) are connected by line segments to give a visualisation of muscle deformation.

SMV4_1Nm. B-mode ultrasound video of 1Nm isometric contraction in participant 5. ASM segmentation results are defined by the yellow x-markers connected by yellow line segments. Within each segment (superficial aponeurosis, fascicle region, deep aponeurosis) markers are coloured using a different palette, and show persisting KLT features (x-markers); newly acquired KLT features (circular markers with halos). The probes are coloured differently depending on whether they are being updated by: i) triangle-based linear interpolation; ii) nearest neighbour interpolation. For example, probes near the `corners' of the gastrocnemius segment tend to lie outside the KLT feature set's convex hull and are therefore moved using nearest neighbour interpolation. Neighbouring probes (that are under the control of the same interpolation method) are connected by line segments to give a visualisation of muscle deformation. Note that this subject does not show muscle activation of the medial gastrocnemius as the low moment required is probably produced through activation of other plantar flexor muscles e.g. soleus.

SMV5_5Nm. B-mode ultrasound video of 5Nm isometric contraction in participant 5. ASM segmentation results are defined by the yellow x-markers connected by yellow line segments. Within each segment (superficial aponeurosis, fascicle region, deep aponeurosis) markers are coloured using a different palette, and show persisting KLT features (x-markers); newly acquired KLT features (circular markers with halos). The probes are coloured differently depending on whether they are being updated by: i) triangle-based linear interpolation; ii) nearest neighbour interpolation. For example, probes near the `corners' of the gastrocnemius segment tend to lie outside the KLT feature set's convex hull and are therefore moved using nearest neighbour interpolation. Neighbouring probes (that are under the control of the same interpolation method) are connected by line segments to give a visualisation of muscle deformation. Note that this subject does not show muscle activation of the medial gastrocnemius as the low moment required is probably produced through activation of other plantar flexor muscles e.g. soleus.

SMV6_VesselExclusion_False. B-mode ultrasound video of 1Nm isometric contraction in participant 3, where the presence of blood vessels results in drift of probes in the fascicle

region. Within the fascicle region of the gastrocnemius markers show persisting KLT features (red, x-markers); newly acquired KLT features (circular markers, surrounded by yellow halos). Blood vessels are visible on the lower left and middle right of the fascicle region. Note that they appear to drift right to left and cause probes to do the same. For example, the bottom left probe in the fascicle region leaves the image completely. This result can be compared with SMV7_VesselExclusion_True, which reduces the impact of blood vessels on probes by excluding short-lived feature tracks from the interpolation calculations.

SMV7_VesselExclusion_True. B-mode ultrasound video of 1Nm isometric contraction in participant 3, where the influence of blood vessels on probe position has been minimised by excluding short-lived feature tracks from the interpolation calculations. Within the fascicle region of the gastrocnemius markers show persisting KLT features (red, x-markers); newly acquired KLT features (circular markers, surrounded by yellow halos); excluded features (surrounded by square, cyan-coloured halos). Blood vessels are visible on the lower left and middle right of the fascicle region. This result can be compared with SMV6_VesselExclusion_False, where the impact of blood vessels on probe position can be seen.

SMV8_KneeBendMvt. Example of tracked movements from the proposed approach (left panel) and cross-correlation approach (right panel) tracking medial gastrocnemius muscle movements captured with B-mode ultrasound imaging (central panel) during deep knee bend movements in participant 6. The grid of 80 probes (proposed approach) or feature templates (cross-correlation approach) were placed to capture movement in the aponeurosis and fascicle regions (see Fig. 1), with placement corresponding to the orientation of the ultrasound image. Note the smooth trajectories of the probe movement predicted by the proposed approach (on average each probe has an average Mutual Information (MI) score of 5.56 bits with the rest of the group). In comparison, the templates tracked by the cross-correlation approach are more erratic corresponding poorly to the movement in the image (average probe MI score of only 3.50 bits). This results from the low feature persistence which occurs during larger movements (see Fig. 5d), contravening the requirement in the cross-correlation approach that features persist and not deform from their reference shape.