

APPENDIX A RENDERED PRESSURE PROFILES FOR EACH MOTION TYPE

Rendered pressure profiles of the haptic feedback during three representative motions from a participant (P26) in the perception study. In forward motion, tactile feedback is distributed across the palmar, thenar, hypothenar, and finger regions, representing the drag-induced resistance against the hand movement. During lateral motion, tactile pressure varies along lateral regions, exhibiting sequential distributions caused by drag-based tangential shear. In contrast, the flexion motion illustrates kinesthetic feedback generated by resistive forces that impede finger bending, modeled as an added mass effect. These profiles correspond to the intended decaying effect and sustained & damping effect, with associated parameters for duration, gamma, and sustained/damping duration to replicate the properties of the inertial fluid.

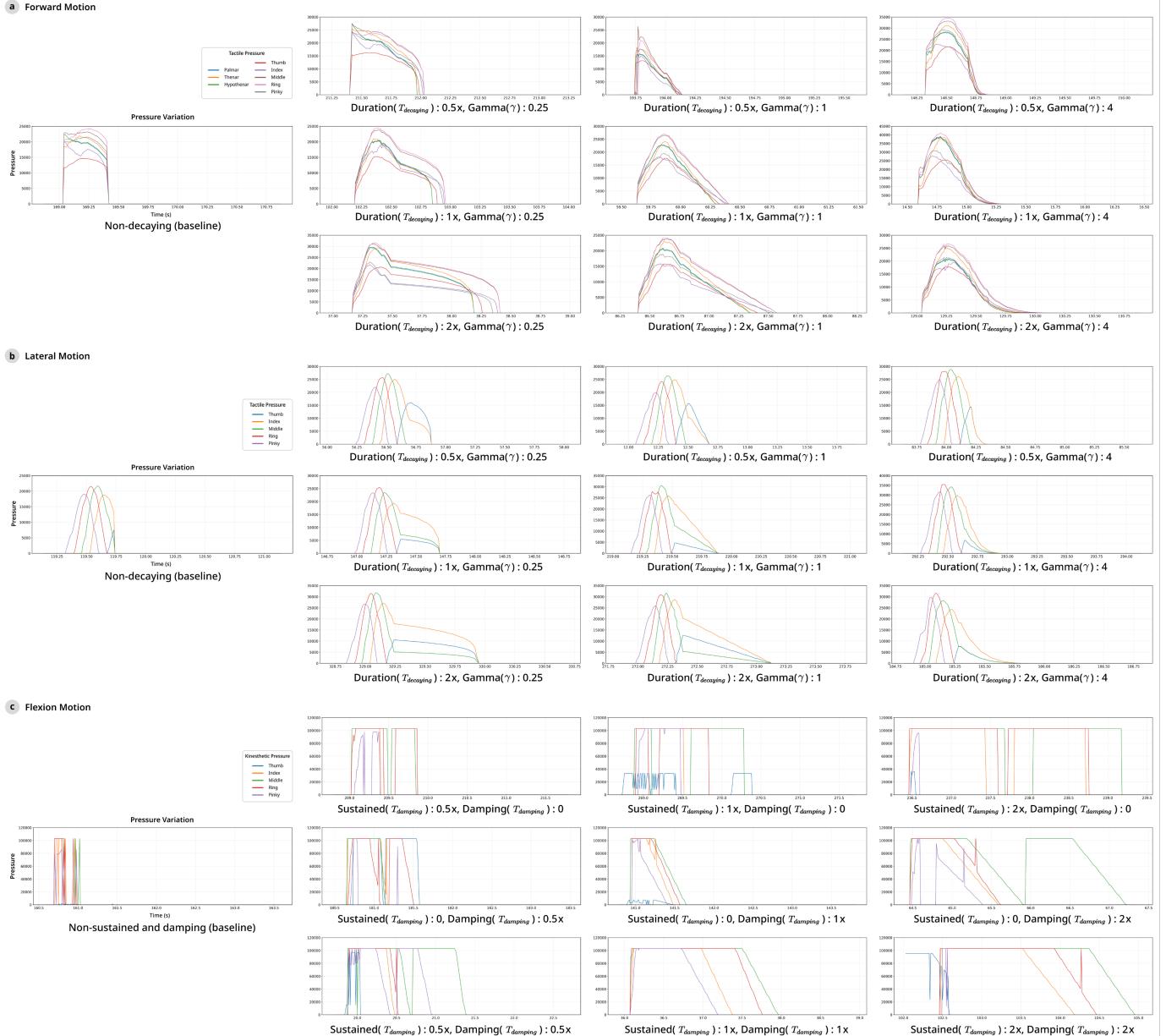


Fig. 1. Time-varying simulated haptic feedback for hand (a) forward and (b) lateral motions, and finger (c) flexion motions. Tactile feedback in forward and lateral motions is rendered proportional to drag forces, while kinesthetic feedback in flexion motion is rendered according to added mass force.

APPENDIX B

TEMPORAL BALANCE OF TACTILE AND KINESTHETIC FEEDBACK

Normalized tactile–kinesthetic pressure balance over time is presented for each rendering condition from a participant (P6) in the application study. The upper plot shows differential pressure between tactile and kinesthetic feedback (Δ Pressure = tactile - kinesthetic) for the left (red) and right (blue) hands, with their average indicated by a dashed yellow line. The gray band (± 0.05) represents the balance zone, where tactile and kinesthetic magnitudes are approximately equal. Positive and negative values denote tactile- and kinesthetic-dominant phases, respectively. The lower plot presents the normalized absolute pressure components for both hands, with tactile shown in light tones and kinesthetic in dark tones. These curves illustrate how tactile and kinesthetic forces evolve and interact throughout the swimming experience using our hand-reflected elements.

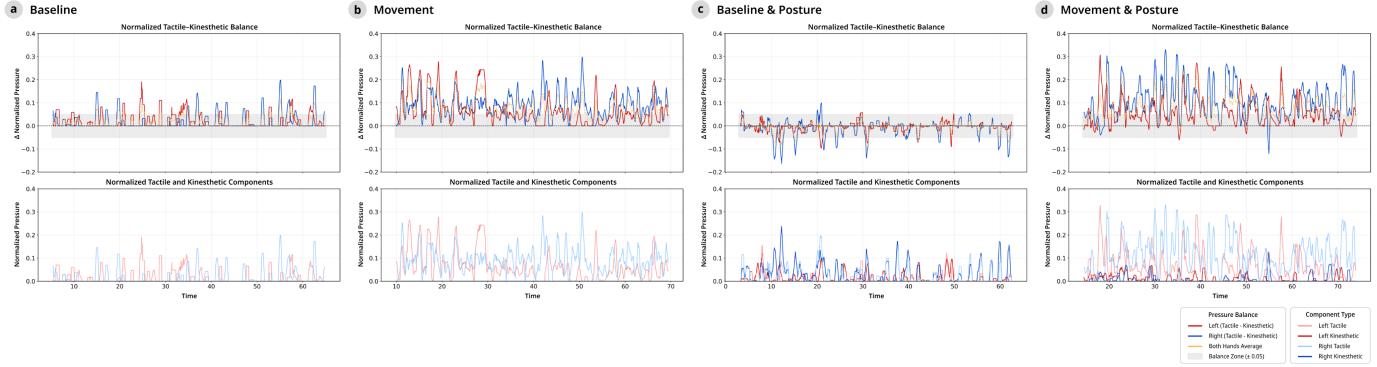


Fig. 2. Distribution of multimodal haptic feedback under different rendering conditions: (a) uniform tactile feedback, (b) sequential tactile feedback along lateral regions, (c) uniform tactile feedback with individual kinesthetic feedback, and (d) tactile and kinesthetic feedback applying all hand-reflected elements.