



Fig. S1. Instantaneous aerodynamic forces and moments of manoeuvring magnificent hummingbird for all axes. All forces are about stroke plane axes and all moments are about body principal axes. Note that in Fig. 4, only fore/aft and lift forces and pitch moment are shown for the pitch pattern; and roll and yaw moments and lateral force are shown for the roll pattern. Forces are normalized by  $m \cdot g$  and moments are normalized by  $m \cdot g \cdot R$ . Colour curves are defined same as those in Fig. 3 and 4. Hovering forces and moments (dashed black curves) are plotted for reference. Average manoeuvring forces and moments are filled circles on the ordinates.