Figure R1: Normalized transverse modal displacement amplitude for mode 1 and 2 derived from numerical modeling. Transverse modal displacements are measured in correspondence with the red circles shown in the sketches: the upper and lower rows represent modal displacements in the XY plane and YZ, respectively.
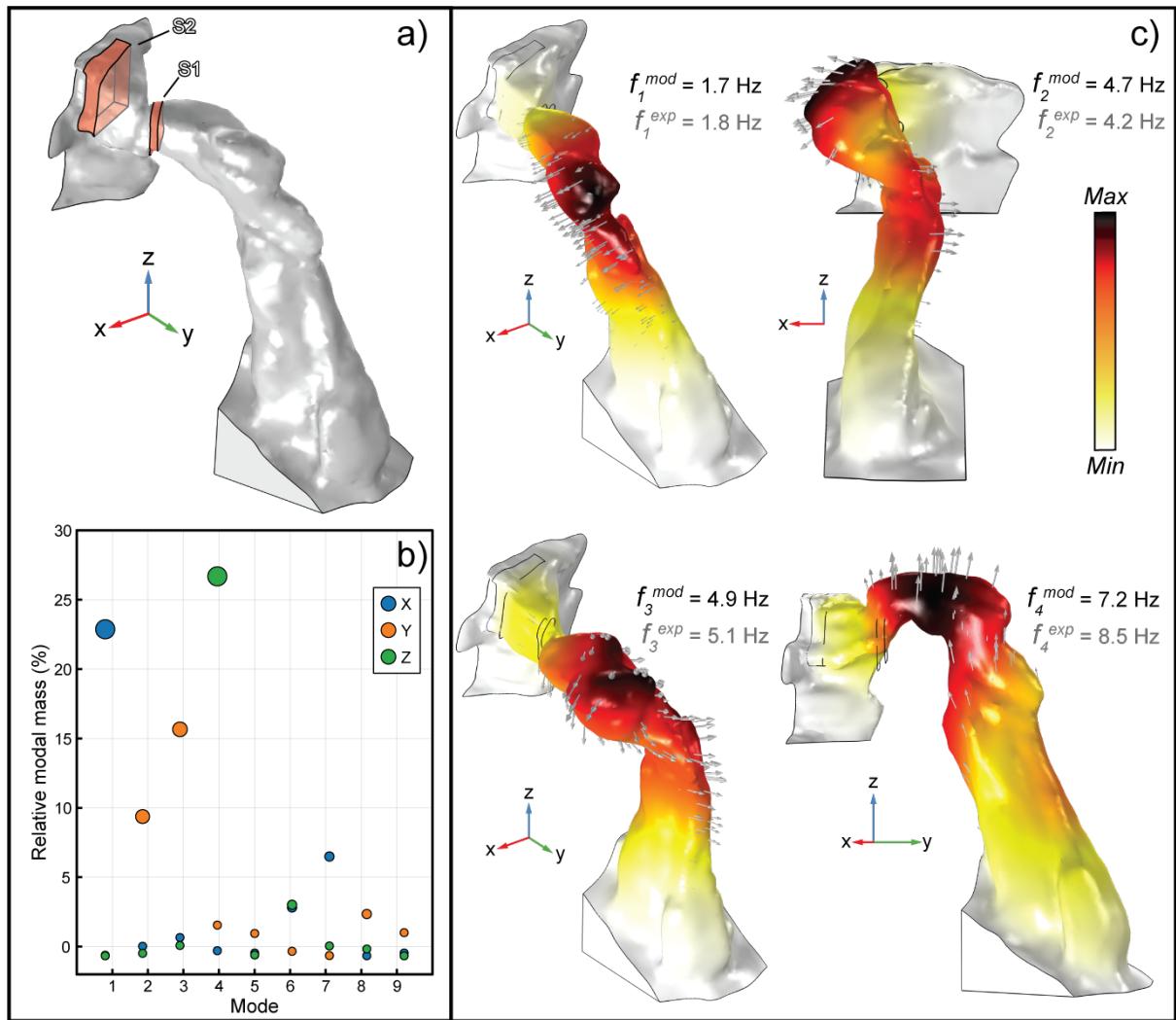
Figure 5: (a) 3D finite element model of Hunter Canyon Arch with detail of S1 and S2 implemented as discrete volumes of reduced elastic modulus (red zones). (b) Relative modal masses in X, Y and Z derived for all modelled modes using the heterogeneous model. (c) Numerical modelling results (modes 1–4) for the reduced stiffness heterogeneous model. Modelled mode shapes and frequencies are shown for each mode (f_n^{mod}), while corresponding measured resonance frequencies are given in gray (f_n^{exp}). Model deformation, colormaps and arrows show zero-phase displacement normalized relative to each mode. Modelled mode 4 (f_4^{mod} = 7.2 Hz) is compared to measured mode 6 (f_6^{exp} = 8.5 Hz) as numerical analysis failed to replicate measured modes 4 and 5.