Figure 5: Solutions of system (1) with $g_{SI} \approx 0.5615 \text{ mS/cm}^2$ overlayed on the critical manifolds of Figure 4 with $g_{SI} = 0.5615 \text{ mS/cm}^2$. The solutions are selected along the first downward peak in Figure 3(a); panel (a) shows a solution just before the minimum of the peak in Figure 3(a) is reached; panel (b) shows one shortly after; panel (c) shows the solutions labelled (d) in Figure 3(a); and panels (d)–(f) show the spike generation as the solution moves up to the next ‘plateau’ in Figure 3(a).

...in Figure 3(a). Interestingly, a double-step ADP is created via a transition from $S^r_1$ to $S^r_2$ as shown. The longest orbit that was previously shown in Figure 3(d), traces unstable sheets $S^r_1$ to $S^r_2$ of $S$ all the way up to the fold $F_3$; see Section 4.2 for more details on this robust transition between two saddle-unstable sheets. After reaching the top fold $F_3$, the membrane potential $V$ initially increases, instead of an immediate decrease down to the stable sheet $S^a_1$, and a small spike is created. As we continue to follow the solution up along the downward peak, the spike part of the orbit segment grows and moves back towards the attracting periodic orbit family $P^a$ as illustrated in Figure 5(d)–(e). Finally, as shown in Figure 5(f), the orbit segment traces $S^r_1$ for only a very short time before the second spike occurs; this orbit segment is selected almost at the end of the downward peak, after which orbit segments stop tracing $S^r_1$ altogether and the transition from a one- to two-spike transient burst ends.

We remark here that the manner of eventual convergence to the resting potential depends on the nature of the lift-off from the slow manifolds that correspond to the sheets $S^r_1$ or $S^r_2$. Recall that $S^r_1$ and $S^r_2$ are both sheets of the critical manifold $S$ that consists entirely of saddle equilibria with only one unstable eigenvalue, that is, each point on $S^r_1$ and $S^r_2$ has a one-dimensional repelling fast component. This means that the associated slow manifolds also have