Summary Accurate characterization of fracture geometry and production profiles is critical for optimizing completion designs in unconventional reservoirs.On average, the 6- cluster stages exhibit longer fracture half- lengths (median ~200 ft vs. ~160 ft), larger stimulated reservoir volume (SRV) per cluster (median ~2.5 ft vs. ~1.0 ft), and slightly higher fracture heights (median ~180 ft vs. ~150 ft) compared with the 10- cluster stag es. While the median fracture conductivity remains similar between the two, greater heterogeneity is observed in the 10- cluster design.Furthermore, the findings offer valuable insights into the impact of different completion designs on fracture geometry and production distribution, contributing to the optimization of completion strategies and the accurate estimation of production performance using fiber- optic strain measurements in unconventional reservoirsRayleigh frequency shift (RFS) distributed strain sensing (DSS) is a powerful diagnostic tool for mapping fracture geometries and identifying production profiles along horizontal wells.Distinct differences exist between the two completion designs: The 10- cluster stages generally exhibit higher peak strain values (median ~32 u?) compared with the 6- cluster stages (median ~22 u?), while the 6- cluster stages present wider strain widths (median ~15 ft vs. ~11 ft).The proposed workflow reduces uncertainty, quantifies fracture geometries, and identifies production profiles, enabling robust completion optimization.This study pioneers the systematic analysis of strain responses measured along an entire horizontal producing well during the shut- in period in unconventional reservoirs, leveraging machine learning-based techniques.A machine learn ing-based Markov Chain Monte Carlo (MCMC) workflow is developed for automated history matching of strain responses along the wellbore.Strain change attributes are assessed at the .levels of completion designs, stages, and clusters