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We solve the Björling problem for timelike surfaces in the Lorentz-Minkowski space through a split-complex representation formula obtained for this kind of surface. Our approach uses the split-complex numbers and natural split-holomorphic extensions. As applications, we show that the minimal timelike surfaces of revolution as well as minimal ruled timelike surfaces can be characterized as solutions of certain adequate Björling problems in the Lorentz-Minkowski space. (Received August 25, 2010)