Independent component analysis (ICA) is highly useful for modeling brain and electroencephalographic (EEG) data. Here, we present a new method that may better capture the dynamics of brain signals than previous ICA algorithms. We assume that a brief, impulse-like activation of an effective signal source elicits a short sequence of spatio-temporal activations in the measured signals. This leads to a model of convolutive signal superposition, in contrast to the commonly used instantaneous mixing model. In the frequency-domain, convolutive mixing is equivalent to multiplicative mixing of complex signal sources within distinct spectral bands. We decompose the recorded complex signals into independent components (ICs) by a complex infomax ICA algorithm. We compare the complex ICs in distinct spectral bands to group together components generated by common EEG processes. Results from a visual attention EEG experiment illustrate differences between real time-domain and complex spectral-domain ICA, and highlight properties of complex ICs.