



KOLLOQUIUM

Institut für Elektrotechnik, Elektronik und Informationstechnik

What is bandwidth?

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The bandwidth of a signal is a fundamental concept whose meaning requires some elaboration. There are (at least) two answers to the question in the title of this talk and we shall discuss both. Every communication engineer is familiar with the “ordinary” notion of bandwidth which is inspired by the Fourier transform. We will call it the *Fourier bandwidth*. Another kind of bandwidth is inspired by the sampling theorem. Massey introduced the notion of Shannon bandwidth for the latter since “Shannon in fact identified bandwidth with the number of signal-set dimensions that are transmitted per second”. The *Shannon bandwidth* is a useful concept in communications, e.g., for defining and understanding spread-spectrum signals. We extend the notion of Shannon bandwidth in such a way that it makes good sense for a pulse as well as for a modulated signal. For a pulse we introduce the notion of *Shannon shift* which leads immediately to a natural notion of its Shannon bandwidth. The maximum possible value of the Shannon bandwidth B is the Fourier bandwidth W .