

1997 Paper 4 Question 1

Continuous Mathematics

Define Gabor wavelets in one dimension in three-parameter form, and explain the meaning of each of the three parameters. [5 marks]

Explain the Gabor–Heisenberg–Weyl “Uncertainty Principle”. Express it as an inequality and define the quantities involved. Explain what is special about Gabor wavelets in terms of this principle. [5 marks]

If you construct an Information Diagram whose axes are time and frequency, how small an area in this plane can be occupied? Illustrate several differently parameterised Gabor wavelets in this plane, and explain what property they all share. How will they compare with all other possible functions in this plane? [5 marks]

Explain in what sense Gabor wavelets unify both the time domain and the frequency domain, constructing a continuous deformation between the two. Explain how the Fourier Transform is just a special case of the Gabor Transform. Discuss the cost implications of using the more general Gabor Transform in terms of the computational difficulty of obtaining the Gabor Transform coefficients. [5 marks]