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Development of a UV Miniaturised Fourier Transform Spectrometer (MicroFTS) for the Detection of Dissolved Organic Carbon in Water

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Within the UK and overseas, there are increasing scientific and water industry needs to acquire spatially and temporally intensive measurements of levels and molecular character of dissolved organic carbon (DOC) in the aquatic environment. The need is particularly acute in upland catchments that are often crucial for drinking water supply, and where DOC concentrations are high and have been increasing in recent years.
Spectrometer-based systems currently on the market for this purpose are heavy, cumbersome, have a large power requirement, not sensitive in low light conditions, measure absorbance at single wavelengths, require frequent recalibration by trained operators and provide data based on hidden algorithms that limit interpretation of the resulting data.
We have developed a new smaller, lighter, and self-calibrating instrument, combining novel miniaturisation of Fourier Transform Spectrometry, and a new scientifically peer-reviewed (and published) approach to assessing DOC concentrations in water.
The portable sensor system uses a xenon flash lamp, where the light pulse is collimated and focused into one input of a bifurcated fibre dip probe. At the fibre tip, light is collimated and reflected in the water sample region over a total path length of 5mm. Shorter wavelengths (near the UV) are absorbed due to water containing DOC concentration. Light from the output end of the bifurcated fibre is collimated and coupled to the micro Fourier Transform Spectrometer. Within the interferometer, a broadband beam splitter and two concave mirrors are used to create an optical path difference between the beams.
A UV sensitive detector is placed at the focus point of the generated interferogram. The interferogram is recorded and a Fourier Transform is applied to retrieve the spectral data. An absorbance of the DOC is measured and when a ratio is taken between the water sample containing DOC and DI water. Both detector and flash-lamp are triggered by an on-board dual wavefunction generator with a delay of 100us between the pulses. The instrument has its own portable power supply for powering the flash-lamp and pulse generator and has the capability and input for connecting with a solar panel for recharging when required.