TFpy: A Python package to analyse and fit time-domain experimental data to transfer function model

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TFpy is a Python package whose aim is to facilitate acquisition, processing and visualisation for frequency-domain data for transfer function models.

Keywords: bode diagrams, complex-space model, python package, transfer function

I. INTRODUCTION

At the basis of any time-domain physical experiment — such as Gravitational-wave detection — is often needed to analyse frequency-domain data, usually presented in the form of a transfer function $H(\nu)$ for which the phase and amplitude diagrams — the Bode diagrams — are useful. Numerous Python packages already exist, most of them of broader spectrum of use,[1,2] some built to meet very specific use-cases.[3,4] All those package however refer to Fourier Transform, or Fast Fourier Transform (FFT) to perform frequency-series calculation, and most of them is not used to fit actual experimental data to a TFM, in a way familiar to us.

The TFpy package is build to address this very purpose, providing a complete toolset for frequency-domain TFM fit and visualisation using Bode diagrams.

A non-tipical application for the Bode diagrams is to fit the transfer function models (TFM) to the experimental data. The main problem to adress is the complex-valued model shape for the transfer function $H(\nu)$. Using the phasor notation the frequency ν is expressed as $s = 2\pi\nu{\cdot}i$, where i is the complex imaginary unit. This way the gain and phase are implicitly obtained from the transfer function, which in itself can be represented in the complex value notation

$$H(s) = |H(s)| \exp[i\phi(s)].$$

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