COST STSM Report:
Reduced basis representations of gravitational waveform templates

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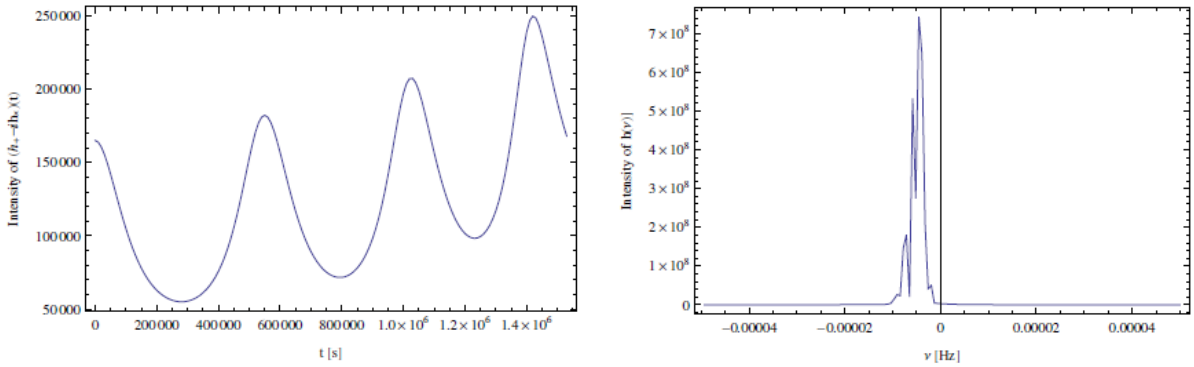
My research aims at developing interpolation techniques in the parameter space of waveforms: with a projection to a lower base, this allows to significantly reduce the number of templates used and the computational demands for search for signals. I would like to efficiently compress and accurately represent the space of waveforms for non-precessing binary black hole inspirals, which constitutes a four-dimensional parameter space (masses of the two components M_1, M_2, eccentricity of the ellipse e, spatial separation between the two components a). This research is intended to lead to a referred publication.

Within the fortnight of the Short Term Scientific Mission, I have got acquainted – thanks to Banglore Sathyaprakash – with one of the group's postdoctoral researcher, Michael Pürrer, whose active research field includes studies of reduced order and surrogate models. I was introduced to the prolegomena required to start with the fundamental principles of reduced basis representation technique. Guided by Dr. Pürrer's corresponding paper (See: arXiv:1402.4146 [gr-qc]), I have reached the first major stage by completing the following steps:

- generated a set of TaylorT4-expanded input waveforms that cover the multi-dimensional parameter space domain
- introduced complex waveforms $h = h_+ - ih_\times$ (given for starting frequency, eccentricity e, and M_1, M_2 in geometrized solar mass in seconds $M_\odot[s] = G/c^3 M_\odot[kg]$)
- developed fast Fourier transforms (FFTs) of the time-domain via
    - discrete sampling of the interpolating functions
    - transformation of samples into the frequency domain



In the next stages where the *Mathematica* code will be further improved, I have to:

1. generate waveforms on a regular grid over the multi-dimensional parameter space
2. define frequency grids separately for amplitudes and phases
3. compute reduced bases for the amplitudes and phases with the SVD
4. interpolate over the parameter space
5. assemble the frequency domain surrogate model

I am most grateful for the support and guidance Prof. Sathyaprakash and Dr. Pürrer have provided and that they have set me in the way. Since a number of unexpected theoretical/technical questions might arise along the way, I rely on their kind assistance. Furthermore, I am looking forward to conduct new collaboration with them in the future in the field of gravitational physics, a collaboration that may lead to further publications.

I wish to seize this opportunity to thank COST for providing me a grant which made it possible to conduct this research and reach the above results.

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