Einladung

zur Fortsetzung des Habilitationsverfahrens von

Herrn Dr. Volker Pohl

Vortrag im Rahmen der Zwischenevaluierung

(Dauer: 45 Min., Vortragssprache: Englisch)

am Mittwoch, den 15. April 2015, 15:00 Uhr (s. t.)

im Raum 1977
in Gebäude Z9, Neubau Innenhof (0509)

„Phase Retrieval in Finite and infinite Dimensional Spaces“

Kurzfassung:

An object can be characterized by measuring how it effects the amplitude and phase of an incident electromagnetic wave. For very short wavelength however, phase information is usually hard to obtain, although it is easy to measure the intensity of the refracted wave. Therefore, the problem of reconstructing the amplitude and phase from amplitude measurements alone, also known as the *phase retrieval* problem, is a very important task in various fields of science and engineering. It has applications in X-ray crystallography, electron microscopy, astronomical imaging, X-ray tomography but also in speech processing, radar, signal theory or quantum tomography, to mention just a few.

To compensate for missing phase information, one may use prior knowledge about the signal to reconstruct the complex-valued signal without any phase information. If no, or not sufficient, prior knowledge is available, one can try to design very particular amplitude measurements to facilitate signal recovery. The later approach prompted two important lines of research in phase retrieval:

1. For which measurement designs can signal recovery be guaranteed?
2. Which measurement designs allow a stable and efficient signal reconstruction?

For *N*-dimensional Euclidian vector spaces $\mathbb{C}^N$, it is now known that $4N - 4$ amplitude measurements of the form $c_n = |\langle x, \phi_n \rangle|$ are necessary and sufficient to guarantee the recovery of any $x \in \mathbb{C}^N$. However, recovery need not to be stable in this case. For stable recovery, the most common recovery approaches are based on semidefinite programming, using $M = \mathcal{O}(N)$ or $M = \mathcal{O}(N \log N)$ Gaussian-random measurement vectors ϕ_n. The most popular algorithm in this context is known as *PhaseLift*. However,

since semidefinite programs are computationally expensive, faster numerical methods are desired. Moreover, Gaussian-random measurements are often not appropriate to model practical measurement procedures. Consequently, there are many affords to identify deterministic, specially designed measurement vectors which guarantee a stable and efficient signal recovery.

In this talk, we present the construction of $4N - 4$ deterministic measurement vectors ϕ_n which guarantee phaseless signal recovery in $\mathbb{C}^N$ excluding only signals from a specific known subspace. For the proposed measurement ensemble $\{\phi_n\}$ an algebraic recovery algorithm is presented whose computational complexity grows only linearly in the dimension N of the vector space, and we will provide upper bounds on the reconstruction error under noisy measurements. Additionally, it is shown that PhaseLift will successfully recover generic signals from phaseless measurements taken with the proposed measurement ensemble. Finally, the practical implementation of the proposed measurement mythology is discussed and we present numerical simulations which illustrate the effectiveness of the recovery algorithms.

To date, most of the work in phase retrieval was done for signals from finite-dimensional spaces. The second part of this talk will focus on the extension of the above ideas to infinite-dimensional signal spaces, such as the important space of bandlimited signals with finite energy. For such signals, we present a measurement setup which allows signal recovery form phaseless signal samples taken at a rate of 4 times the Nyquist rate. At the end of the talk, we give an outlook, how the proposed phase retrieval methods can be extended to signal spaces which satisfy a sparsity prior.

Der Vortrag ist **hochschulöffentlich**.

Dekan Prof. Dr. Paolo Lugli

Die Einladung zum hochschulöffentlichen akademischen Vortrag richtet sich an die:

Mitglieder des Fachmentorats,
Mitglieder des Fakultätsrats EI,
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Zum hochschulöffentlichen akademischen Vortrag wird hiermit insbesondere eingeladen:

der Präsident der TUM,
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und per Aushang
die interessierte Hochschulöffentlichkeit.