

ترکیب شبکه های عصبی مصنوعی برای تجزیه داده های سری زمانی و تحلیل پارامترهای مدل

محمد ایران دوست

زمستان ۱۳۹۹



یازدهمین کنفرانس فیزیک آماری،
ماده چگال نرم و سیستم های
پیچیده

بررسی سری‌های زمانی

تجزیه با شبکه عصبی مصنوعی

Neural Decomposition of Time-Series Data for Effective Generalization

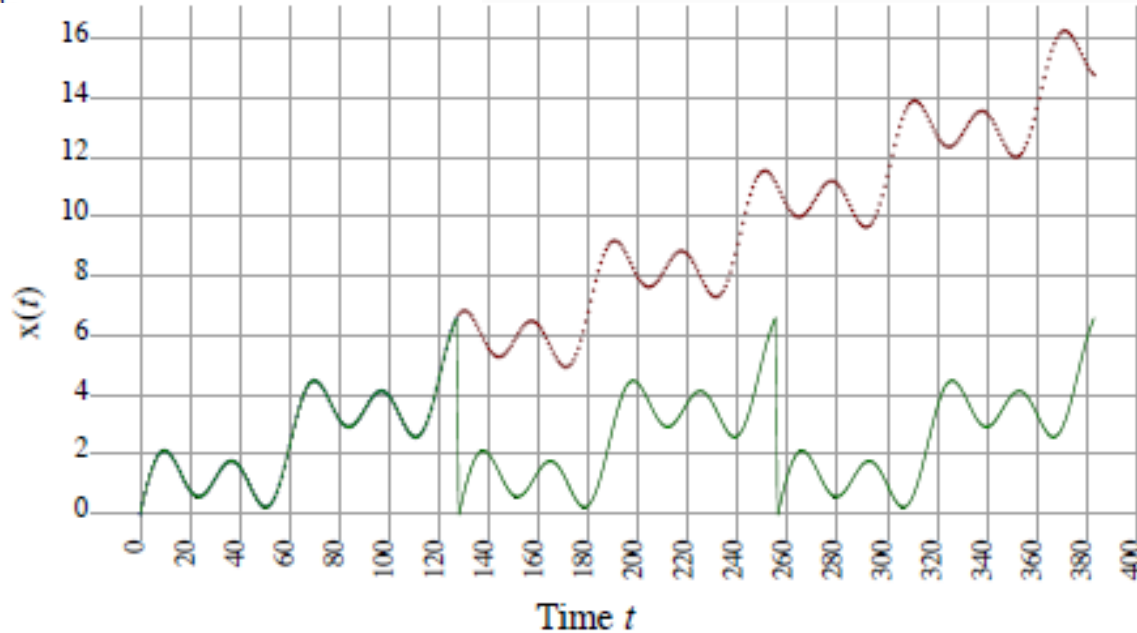
Luke B. Godfrey and Michael S. Gashler
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University of Arkansas
Fayetteville, AR 72701
Email: {lbg002, mgashler}@uark.edu

Abstract—We present a neural network technique for the analysis and extrapolation of time-series data called Neural Decomposition (ND). Units with a sinusoidal activation function are used to perform a Fourier-like decomposition of training samples into a sum of sinusoids, augmented by units with nonperiodic activation functions to capture linear trends and other nonperiodic components. We show how careful weight initialization can be combined with regularization to form a simple model that generalizes well. Our method generalizes effectively on the Mackey-Glass series, a dataset of unemployment rates as reported by the U.S. Department of Labor Statistics, a time-series of monthly international airline passengers, the monthly ozone concentration in downtown Los Angeles, and an unevenly sampled time-series of oxygen isotope measurements from a cave in north India. We find that ND outperforms popular time-series forecasting techniques including LSTM, echo state networks, ARIMA, SARIMA, SVR with a radial basis function, and Gashler and Ashmore's model.

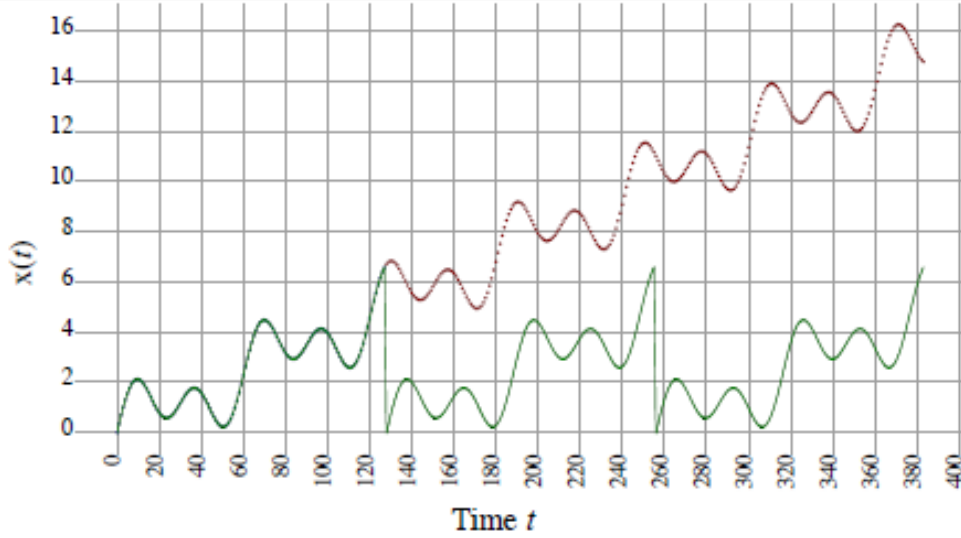
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Recurrent
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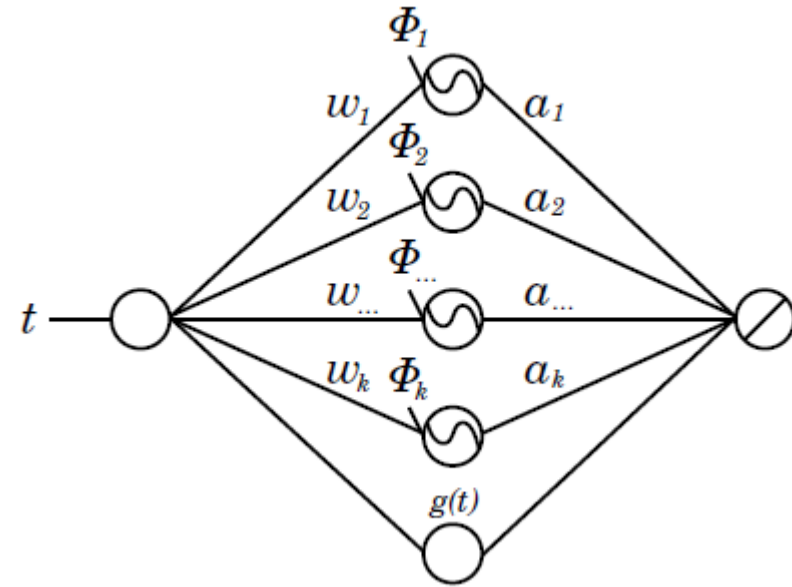
We claim
regression and
properties: (1)



تجزیه با شبکه عصبی



$$x(t) = \sum_{k=1}^{\infty} (a_k \cdot \sin(\omega_k t + \phi_k)) + g(t)$$



توانایی‌های شبکه عصبی

تجزیه با تبدیلات عکس فوریه

تجزیه با شبکه عصبی مصنوعی

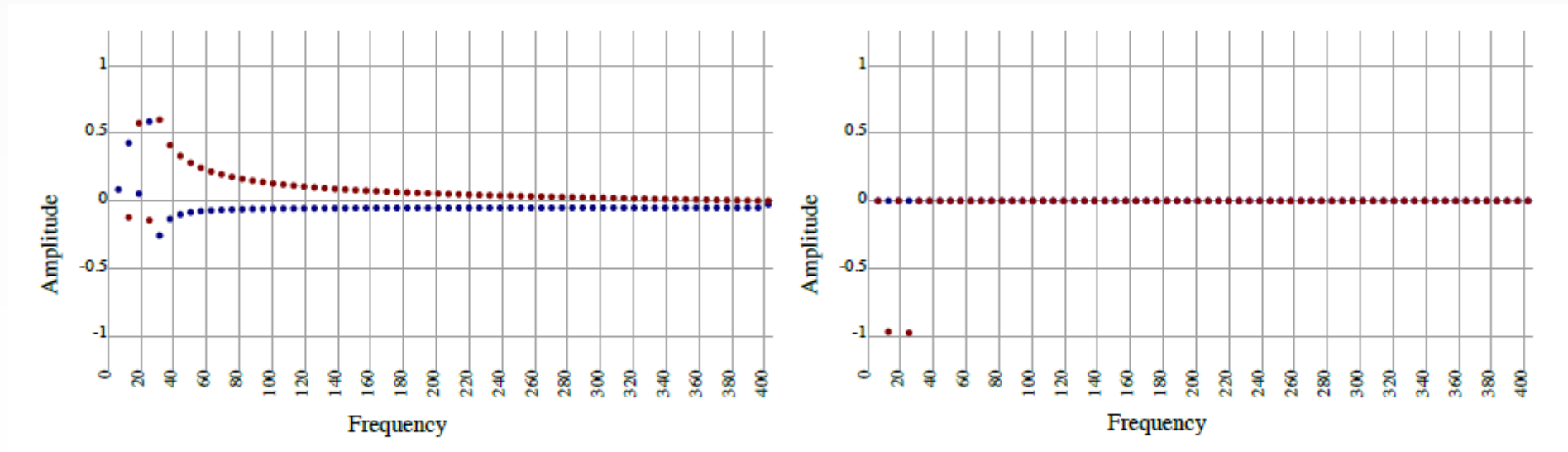


Fig. 6. Frequency domain representations of the toy problem (amplitude vs frequency). (Left) Frequencies used by the iDFT. (Right) Frequencies used by ND.

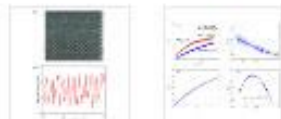
اطلاعات نهفته در داده‌های میکروسکوپ نیروی اتمی

Multiscaling behavior of atomic-scale friction

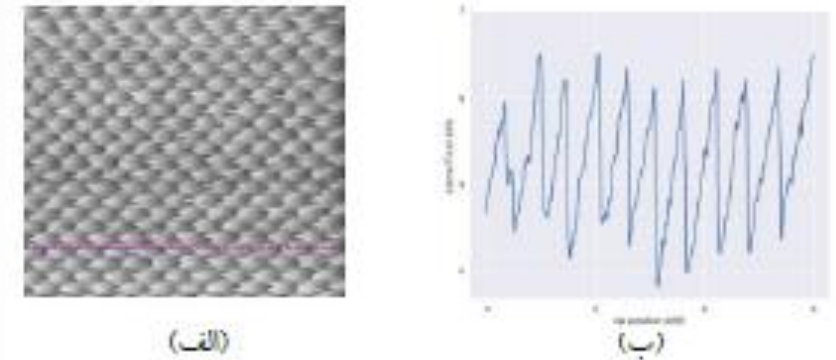
M. Jannesar, T. Jamali, A. Sadeghi, S. M. S. Movahed, G. Fesler, E. Meyer, B. Khoshnevisan, and G. R. Jafari
Phys. Rev. E **95**, 062802 – Published 19 June 2017

ABSTRACT

The scaling behavior of friction between rough surfaces is a well-known phenomenon. It might be asked whether such a scaling feature also exists for friction at an atomic scale despite the absence of roughness on atomically flat surfaces. Indeed, other types of fluctuations, e.g., thermal and instrumental fluctuations, become appreciable at this length scale and can lead to scaling behavior of the measured atomic-scale friction. We investigate this using the lateral force exerted on the tip of an atomic force microscope (AFM) when the tip is dragged over the clean NaCl (001) surface in ultra-high vacuum at room temperature. Here the focus is on the fluctuations of the lateral force profile rather than its saw-tooth trend; we first eliminate the trend using the singular value decomposition technique and then explore the scaling behavior of the detrended data, which contains only fluctuations, using the multifractal detrended fluctuation analysis. The results demonstrate a scaling behavior for the friction data ranging from 0.2 to 2 nm with the Hurst exponent $H = 0.61 \pm 0.02$ at a 1σ confidence interval. Moreover, the dependence of the generalized Hurst exponent, $h(q)$, on the index variable q confirms the multifractal or multiscaling behavior of the nanofriction data. These results prove that fluctuation of nanofriction empirical data has a multifractal behavior which deviates from white noise.



رفتار مقیاسی در اصطکاک ابعاد نانو



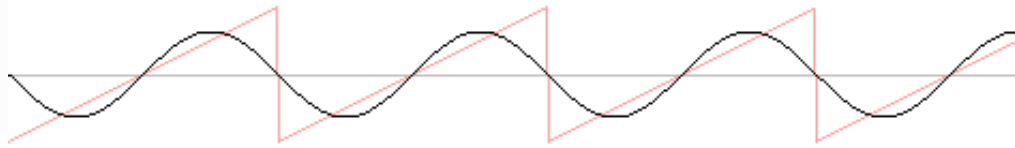
نیروی جانبی وارد بر سوزن میکروسکوپ نیروی اتمی (AFM) حین حرکت بر سطح بلور NaCl در جهت (001). شکل الف تصویر دوبعدی (بزرگی نیرو متناسب با شدت رنگ) و شکل ب نمایش همان نیرو در راستای خطی که در (الف) با نقطه چین مشخص شده است

شناسایی روندها

موج دندان اره‌ای

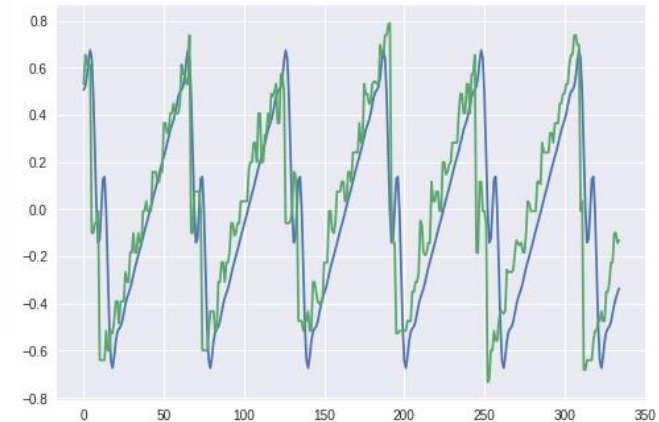
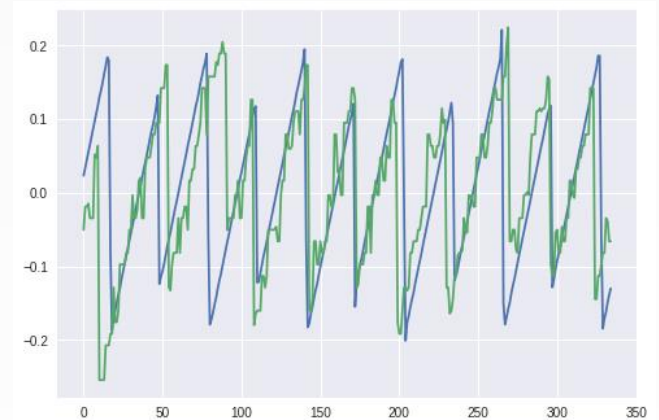
$$\sin(x) - \frac{1}{2}\sin(2x) + \frac{1}{3}\sin(3x) - \frac{1}{4}\sin(4x) + \frac{1}{5}\sin(5x) - \frac{1}{6}\sin(6x) + \dots$$

harmonics: 1



درجات آزادی متناوب

$$Y_{sin}(x) = \sum A_i * \sin(K_i * x + \varphi_i + i\pi/2).$$



نتایج

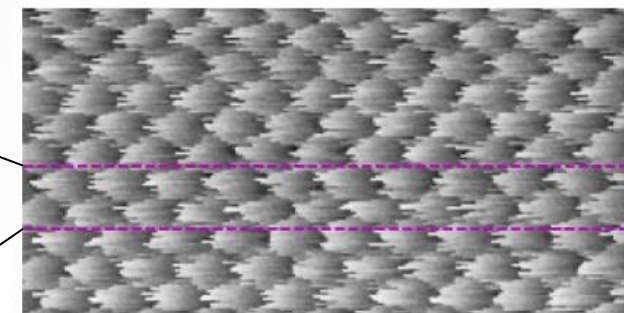
تصویر خروجی

بازسازی شده با ترکیبی از شبکه‌های عصبی مصنوعی



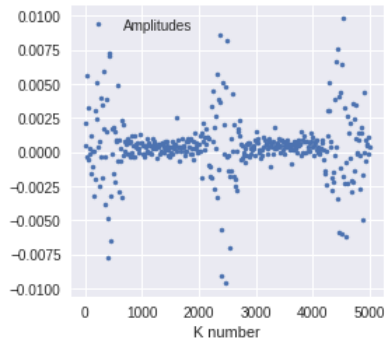
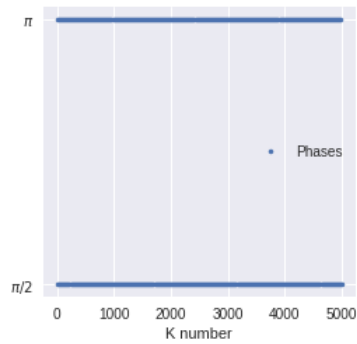
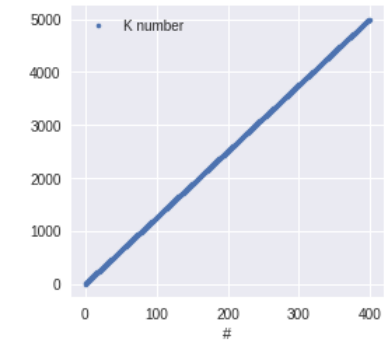
تصویر ورودی

برداشت شده توسط
میکروسکوپ نیروی اتمی

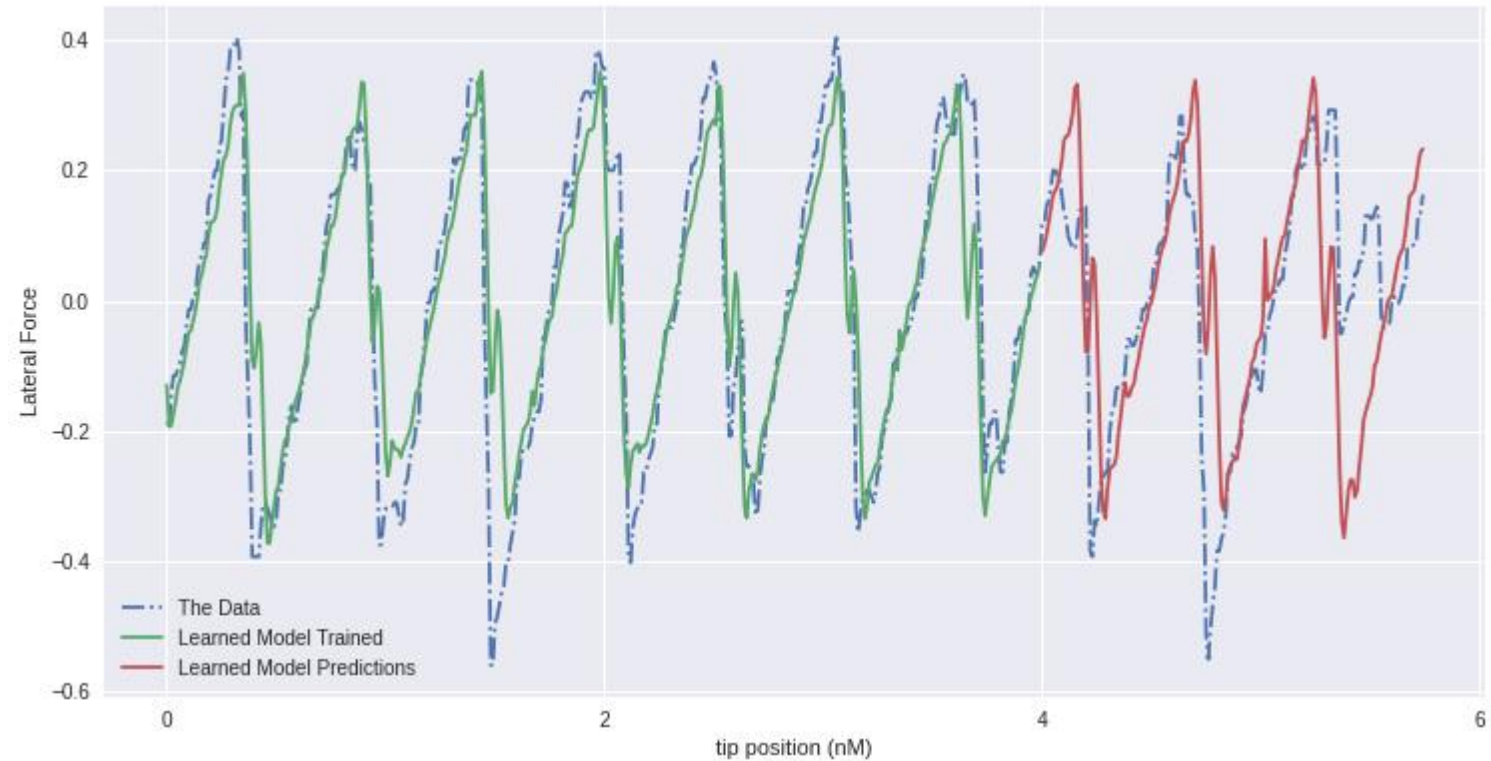


نگاهی دقیق‌تر به خروجی‌ها

The Periodic Part Parameters

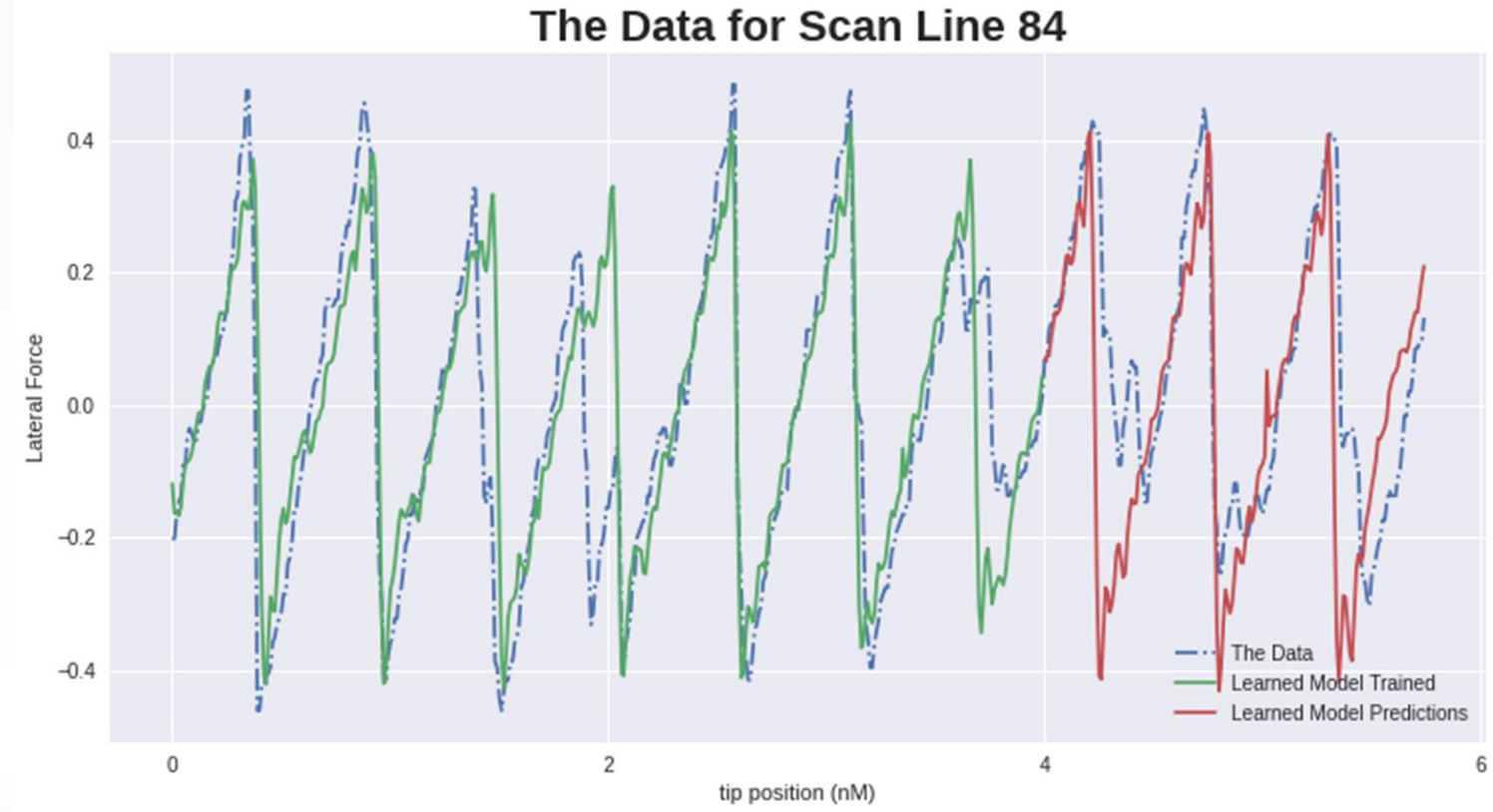
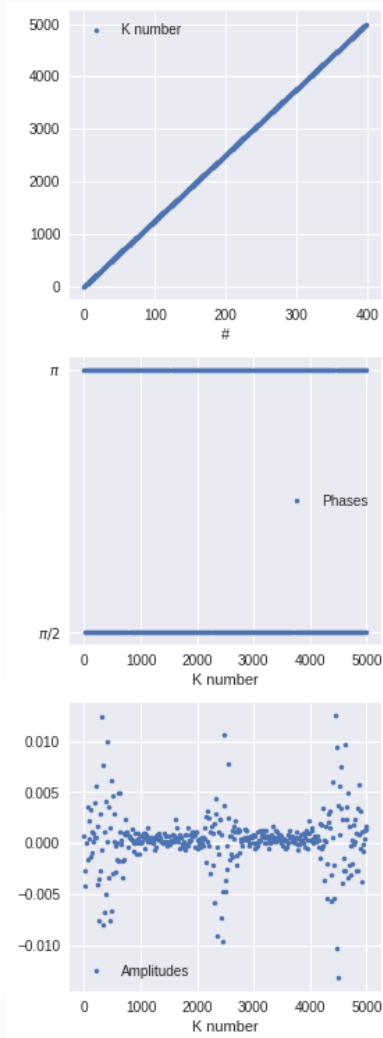


The Data for Scan Line 80



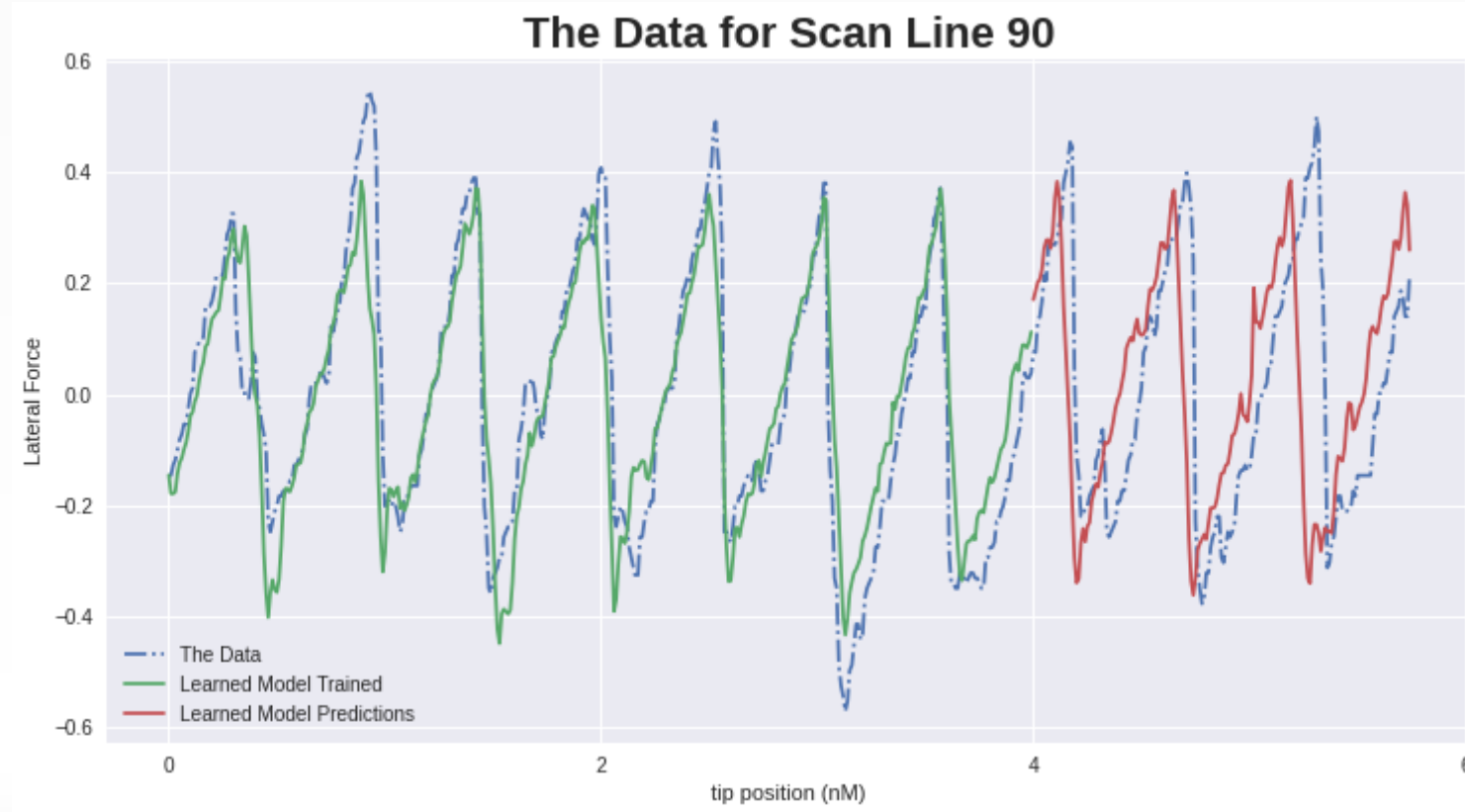
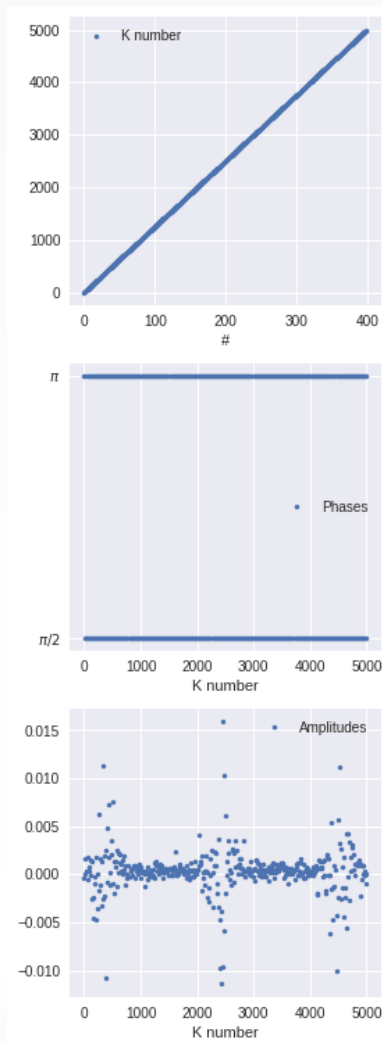
The Periodic Part Parameters

نگاهی دقیق‌تر به خروجی‌ها

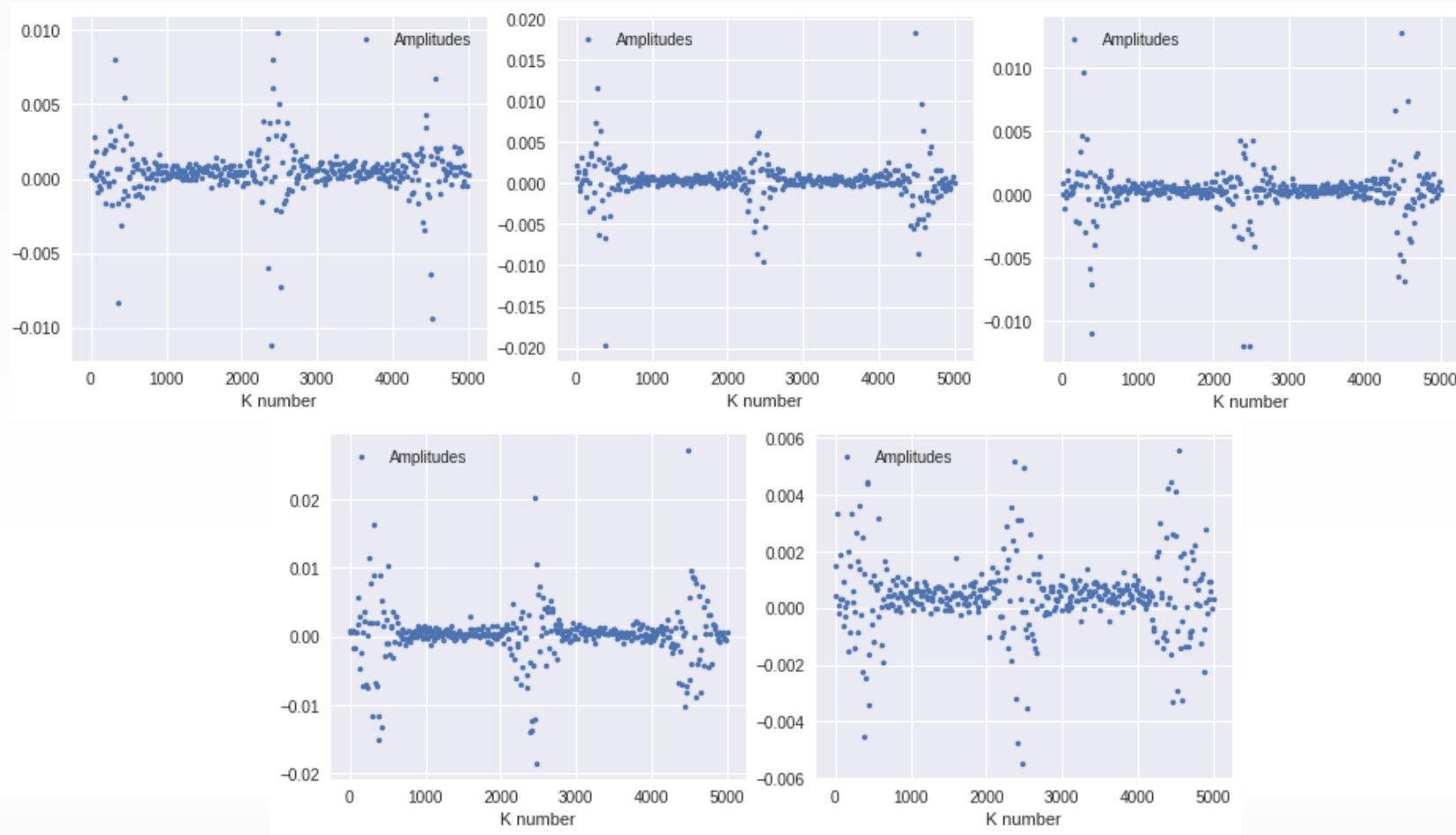


The Periodic Part Parameters

نگاهی دقیق‌تر به خروجی‌ها



مقایسه برای شرایط مختلف



سپاس از توجه شما! 😊