Erasmus+

Final Internship report

Blind Detrending of the CHOEPS observations using a Neural Network





1 Preparation for the Internship

My internship opportunity emerged while I was working on my Master's thesis rather than through a conventional internship search, which could include applying through online portals. Towards the end of the technical part of my thesis, I started applying for potential PhD positions to continue my work in astrophysical data analysis and machine learning in exoplanet science. I contacted Dr. A. B., one of my supervisor's collaborators, for general advice regarding possible PhD and research internship opportunities in this field. During this discussion, he proposed a project related to the blind detrending of CHEOPS observations using neural networks. Since the project was closely connected to the skills I had developed during my Master's work and appeared manageable within a month or two, I decided to pursue this opportunity while writing the final chapters of my thesis and applying for PhD positions.

Dr. A. B. has been participating in the CHEOPS mission consortium and collaborating with several other researchers in the field. The project was well defined and was expected to provide several opportunities to further develop my existing skills. Moreover, it was a good opportunity for me to experience a different research environment and work culture at Stockholm University in Sweden.

Keeping in mind that Stockholm could be very expensive, I decided to start searching for accommodation as soon as I received the Learning Agreement. While trying to contact Stockholm University's housing services, I learned that interns were generally not eligible to apply for university accommodation for such a short duration. A stay of at least three months might be considered for some rooms or apartments, but even then, the chances of receiving an offer could involve a long waiting period. To avoid delays and higher costs, I explored several other options, including Facebook groups and student portals where students post advertisements for short-term accommodation. At first, confirming a stay with someone through a social media platform such as Facebook seemed daunting, so I remained cautious and paid particular attention to avoiding potential scams.

As this was my first time staying in Stockholm, Airbnb seemed to be a more reliable and safer choice for arranging accommodation in advance. The city is really beautiful and very well connected by metro and buses, so staying outside the city centre is not necessarily a disadvantage. Since the astrophysics department is located at AlbaNova, I decided to search for a place, typically a studio apartment, within approximately 30 minutes of travel time. Fortunately, I found that accommodation in the Himlabacken area was mostly occupied by students or researchers visiting KTH or Stockholm University. The area was not only considered safe, but also offered affordable housing options that could be covered within the available funding. It was approximately eight minutes on foot from the nearest metro station, Bergshamra, and a nine-minute metro ride from there to the city centre, making it a very convenient location for the internship. I have highlighted the area in the picture below (Figure 1).

2 Activities during the Internship

The internship began on Monday, 6 July, when Dr. B. picked me up at the entrance of the Astrophysics building. I was given an access card, which was used for entering and exiting the building and my office. Dr. B. also gave me a very interesting tour of the building, including a visit to the newly installed telescope on the roof. I was introduced to the different meeting and seminar rooms, as well as to the researchers working in the

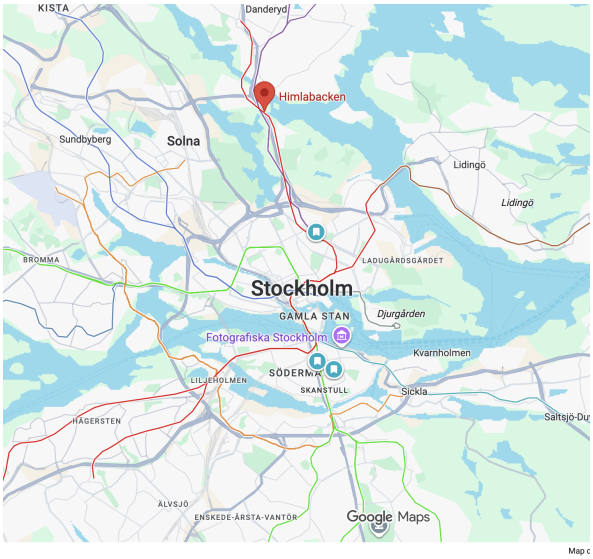


Fig. 1: The Himlabacken area, approximately 8 minutes on foot from Bergshamra metro station.

building and their respective research topics, so that I could reach out to them in case I was interested in further discussions. I was also given my own personal office, which provided a comfortable environment for working independently. However, I would have preferred to be in the same room with other Master's or Bachelor's students, as this could have provided more opportunities for informal discussions. The pictures in Figure 2 show my office and the Stockholm University building during the physical mobility period.

One small but memorable aspect of the access card was that if someone forgot the card inside their office and pulled the door closed, the only possible way to enter the office again was to find a person responsible for the office keys or one of the group leaders. If neither was present, it could become a very bad day for that person. Therefore, I quickly developed the habit of making sure that I always kept the card with me. Fortunately, on the one occasion when I forgot it, Dr. B. was present and could access my office.

Regarding the supervision of my project, in addition to Dr. B., two postdoctoral colleagues, Ella and Alex, were assigned to me as my co-supervisors. Both are experts in machine learning and were closely involved in the technical aspects of the project. After my initial meeting with Dr. Brandeker, we all met together to define more concrete steps towards achieving the goal of the project. We decided that I would present my results and progress each week, followed by a discussion to see whether any changes in direction or additional steps were needed. At the same time, all of them were always very approachable if I had any doubts or problems to solve, and I could simply go to their offices and knock on the door. I was also able to ask for additional supervision meetings whenever needed.

Since the project involved training a neural-network model, we agreed to use a Jupyter Notebook-based Python approach for simplicity until we obtained reasonable results. The project started with the goal of selecting suitable data, for which I was able to use the machine-learning classifier that I had developed during my Master's thesis to filter the required datasets automatically. For writing down the main findings and keeping track of the project flow, I also used the whiteboard present in my office. This was followed by organising the datasets into a proper format, developing the required Python functions for data reduction, and finally structuring the inputs in the right way to train the neural-network model. As we decided to use an MLP model, I was also given some time to become familiar with its working principles



Fig. 2: My office (left) and the Stockholm University building (right) during the physical mobility period.

and implementation.

To discuss the progress, we all went through my code, datasets and plots together, so that all of us would be on the same page and use the same terminology. To equip me with a better intuition for the MLP, Alex and Ella even set up a small crash course for me, which was very helpful in translating the inner workings of the model into a scientific perspective. I also realised that it was somewhat challenging for me to present technical models directly from a Jupyter Notebook while keeping track of the details during speaking and connecting them well with the scientific point I wanted to make. After discussing this with Ella and Alex, their feedback helped me improve my articulation and the way I structured my presentations.

By the last week of the physical mobility period, I had already trained several versions of the MLP model, and we all discussed these results together. We realised that the trained model was not yet performing up to the expected level for the detrending task. This could have been related to the chosen target variable used during the learning process. When the virtual period started, I therefore had to rerun my processing pipeline using the new learning variable. After several iterations with different models and configurations, the detrending results started to look more reasonable, as we had expected. This was a positive development and showed that the approach could produce promising results when the appropriate learning variable and model configuration were used. The work also provides a basis for further testing and development of the method on additional CHEOPS observations.

What I really liked about Dr. B. was that he would always ask how the project had been going so far and, if I had any doubts, would find the time to sit down and explain the concepts to me. This also applied to my two co-supervisors, who were always willing to discuss technical questions and provide feedback.

Apart from working on the tasks, I also enjoyed interacting with other people present dur-

ing my internship. I had very enjoyable lunches with a French colleague, particularly listening to her stories about the city and life in Stockholm. We developed a good bond very quickly. People from other departments were also friendly. I also had the opportunity to meet Prof. Dr. M. J. and learn more about his work on direct imaging methods in exoplanet science. These interactions gave me a broader impression of the research environment beyond my own project.

There were only two main downsides that I found during the internship. The first was that I had to use my own laptop, as no computer was provided to me. I am not sure whether a computer could have been provided if I had asked for one, so this might be something worth clarifying for future interns. The second was the timing of my physical mobility period. I was there in July, which is a holiday month in Sweden, and therefore I could not meet as many people as I had wanted to in order to build a wider professional network. In addition, the university canteen was closed during this period, and this also affected t he F ika culture at the departmental level. Fika is a tradition where people gather in the afternoon, usually around 3 pm, for a few minutes to chat, enjoy traditional filter c offee an d ha ve something sweet. I was therefore not able to participate in as many Fika gatherings as I had expected.

3 Acquisition of practical skills and reflection on the traineeship

After spending over a month in gorgeous and friendly Stockholm, I would say that my overall experience at Stockholm University was very positive. The campuses were easily reachable by public transport, and I found the research environment friendly and without much micromanagement. I was given enough freedom to take my time to develop and learn things independently. The project tasks were also very well connected to my previous experience, and I could extend this knowledge further through the addition of neural-network methods. As mentioned before, due to July being a holiday month, many people were away, so it was not really the social atmosphere at the university where I could meet as many people as I would have liked. One expectation I personally had was to have my own computer system, which was not provided, and this upset me a little. Eventually, I managed with my own laptop, but having a university system would have made me feel more comfortable and integrated into the workplace. I also would have liked to be introduced to more people by my supervisors or co-supervisors. In addition, I could not get to know my supervisors as well personally as I had expected, partly because they usually went to restaurants for lunch while I brought my own lunch from home.

During the internship, I gained practical experience in working with astronomical time-series data and applying machine-learning methods to a real scientific problem. I improved my skills in Python, data reduction, dataset preparation and neural-network modelling, particularly through the implementation and testing of different MLP configurations. I also learned that developing a scientific machine-learning method often requires several iterations and that choosing an appropriate learning target can be as important as choosing the model itself. The project therefore helped me become more comfortable with troubleshooting, interpreting model results and making changes based on the observed performance.

Before starting the internship, I expected the experience to be mainly focused on the technical development of the detrending method, and this expectation was largely fulfilled. At the same time, I gained more than technical knowledge. The weekly presentations and discussions helped me improve how I communicate technical results and connect them with

their scientific meaning. The feedback from my supervisors was particularly useful in this regard. Overall, the internship gave me a better understanding of how research is carried out in an international academic environment and strengthened both my technical and scientific skills.