Northwestern

Jack Hanke <jackhanke2025@u.northwestern.edu>

Continuing BH Emulation as an Independent Study

8 messages

Jack Hanke <jackhanke2025@u.northwestern.edu> Tue, May 27, 2025 at 8:00 AM
To: Ermin Wei <ermin.wei@northwestern.edu>, atchekho@northwestern.edu

Sasha and Ermin,

Good afternoon! I am emailing to formally request continuing work on the Black Home Emulation project as part of an independent study for the Fall 2025 quarter.

I know you both mentioned that you would be happy for any members of our group to continue working on the project. If this is still the case, I will need to fill out a form for my program to describe the independent study. The questions, in italics, are below, as well as my initial responses to them are below.

1. Which department are you requesting to do your independent study? (ex. MSAI, COMP_SCI, ELEC_ENG, etc.)
The MSAI department. (or the physics department?)

2. Who is the Professor who will be overseeing your project?
Sasha and/or Ermin

3. Please provide a description of the work to be completed.
direct except from original proposal should be fine

4. Please provide a description of the goals from an application, product, or user perspective.
direct except from original proposal should be fine

5. Provide a description of the technical approach being taken.
direct except from original proposal should be fine

6. Attach confirmation that a conversation happened between student and the professor.
Presumably this email chain should be enough.

Thank you for the help! I look forward to continuing this project!

Best,
Jack Hanke
MSAI Class of 2025

Sasha Tchekhovskoy <atchekho@northwestern.edu> Tue, May 27, 2025 at 10:42 AM
Reply-To: atchekho@northwestern.edu
To: Jack Hanke <jackhanke2025@u.northwestern.edu>
Cc: Ermin Wei <ermin.wei@northwestern.edu>

Hi Jack,

So excited to work with you through an independent study!

> *1. Which department are you requesting to do your independent study? (ex. MSAI, COMP_SCI, ELEC_ENG, etc.)*
> The MSAI department. (or the physics department?)

Ermin: you mentioned you were already in the MSAI advisor system, so it might be easiest for Jack to indicate you as the advisor through the MSAI department?

> *2. Who is the Professor who will be overseeing your project?*
> Sasha and/or Ermin

If you agree with the above, then indicating Ermin is the easiest.

> *3. Please provide a description of the work to be completed.*
> **direct except from original proposal should be fine**
>
> *4. Please provide a description of the goals from an application, product, or user perspective.*
> **direct except from original proposal should be fine**
>
> *5. Provide a description of the technical approach being taken.*
> **direct except from original proposal should be fine**

Please let me know if you'd like to write up something here -- happy to sit down with you to put it together.

> *6. Attach confirmation that a conversation happened between student and the professor.*
> Presumably this email chain should be enough.

Certainly hope so, but I am also very happy to respond to a specific email where you ask us to confirm that we are happy to work with you over the summer quarter 2025 as part of an independent study.

Cheers!
Sasha

--
Alexander (Sasha) Tchekhovskoy
Associate Professor
Center for Interdisciplinary Exploration and Research in Astrophysics
Department of Physics and Astronomy
1800 Sherman Ave, 8th Floor
Northwestern University
Evanston, IL 60201
[Quoted text hidden]

Jack Hanke <jackhanke2025@u.northwestern.edu> Tue, May 27, 2025 at 6:21 PM
To: atchekho@northwestern.edu
Cc: Ermin Wei <ermin.wei@northwestern.edu>

Sasha,

That is great news! Let me write something up for 3. 4. and 5.

Of course, I won't proceed with filling out the form until Ermin you indicate your approval.

Best,
Jack
[Quoted text hidden]

Ermin Wei <ermin.wei@northwestern.edu> Tue, May 27, 2025 at 6:33 PM
To: Sasha Tchekhovskoy <atchekho@northwestern.edu>, Jack Wiley Hanke <JackHanke2025@u.northwestern.edu>

Hi Jack,

It's great to hear about your interests. I have affiliation with CS not directly with MSAI. Could you find out more about affiliation requirements in order for this credit to count towards your graduation?

I'd be happy to advise/co-advise the project.

Also we are talking about fall quarter, not summer quarter, right?

Best,
Ermin

From: Jack Hanke <jackhanke2025@u.northwestern.edu>
Sent: Tuesday, May 27, 2025 4:21:13 PM
To: Sasha Tchekhovskoy <atchekho@northwestern.edu>
Cc: Ermin Wei <ermin.wei@northwestern.edu>
Subject: Re: Continuing BH Emulation as an Independent Study

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Sasha Tchekhovskoy <atchekho@northwestern.edu> Tue, May 27, 2025 at 9:40 PM
Reply-To: atchekho@northwestern.edu
To: Ermin Wei <ermin.wei@northwestern.edu>
Cc: Jack Wiley Hanke <JackHanke2025@u.northwestern.edu>

Ermin, good catch regarding summer vs fall. Jack, I remember you mentioned doing an independent study over the summer -- which one(s) are you interested in? Cheers, Sasha
[Quoted text hidden]

Jack Hanke <jackhanke2025@u.northwestern.edu> Wed, May 28, 2025 at 12:04 AM
To: atchekho@northwestern.edu

This would be for the fall 2025 semester, as I'll be working over the summer. I will email the program director about the affiliation and let you know!

Best,
Jack
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Sasha Tchekhovskoy <atchekho@northwestern.edu> Wed, May 28, 2025 at 1:06 AM
Reply-To: atchekho@northwestern.edu
To: Jack Hanke <jackhanke2025@u.northwestern.edu>, Ermin Wei <ermin.wei@northwestern.edu>

Great! We are happy to work with you any quarter, so Fall definitely works for us. Let us know what you find! Cheers, Sasha
[Quoted text hidden]

Jack Hanke <jackhanke2025@u.northwestern.edu> Mon, Jun 2, 2025 at 2:01 PM
To: atchekho@northwestern.edu
Cc: Ermin Wei <ermin.wei@northwestern.edu>

Good afternoon Sasha and Ermin,

I hope all is well! Apologies in advance for the long email.

The MSAI practicum team will be presenting our final work tonight at Ford. Though we put considerable effort into our modeling, and obtaining a relatively low MSE relative to what we were getting (1.8 validation MSE), our results aren't great. Please find attached the current best we were able to generate. We will mention this in our presentation, but we will also highlight the generally-useful work we did for doing machine learning with the *harm2d* codebase. Additionally, the path ahead for significant improvements is very clear. These improvements include:

Logistics-wise...
1. Most importantly, further improving the dump read time, and doing so in a way that does not utilize global variables. This will require some development work with Aris/Sasha/other developers familiar with internals of *harm2d*,

especially the *pp.py* function
2. Once 1 is achieved, organization and improvements for the codebase will quickly fall into place
3. Rewrite plotting and rendering to not use global variables, in the same way for 1.

Modelling-wise...
1. Creating a VAE for the harm2d data
2. Creating the latent harm2d dataset
3. Then create a prediction UNet for the latent dataset. This is in line with other SOTA image-to-image architectures like stable diffusion.
4. In line with the success of using skip connections in our current network (called *b3* from the proposal), explore if predicting the difference among frames improves performance?

Physics-based...
1. Decide on how to modify the traditional MSE, 3D convolution architecture to best reflect physics in the system

I am more than willing to see the above TODO list as the statement of work for the upcoming independent study, along with other things.

I admit, given all the effort I'm disappointed in the results, but it does give me even more motivation to improve the results in the coming quarter. Let me know what you think!

Best,
Jack
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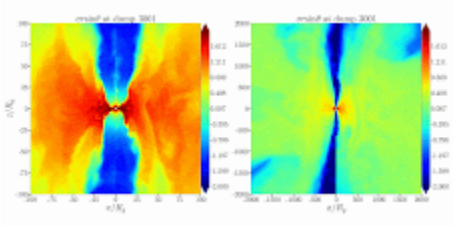

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