Capstone Project Prospectus and Registration information

Spring 2021

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*Denoising using Noise-to-Noise*

**Prospectus**

**Category (development /research)**

**research**

**Explain in a few sentences the chosen category (research/development)**

**Our Project belongs to the research category because we want to:**

1. **refine the parameters of the Noise-to-Noise algorithm, for better results.**
2. **Find a suitable Network type for the Noise-to-Noise implementation.**

**Keywords (hashtags):**

**Convolutional neural networks, CT denoising, X-ray denoising, medical image denoising.**

**Synopsys:**

*Please* provide a **short** description of the fundamental need and existing challenges for this project.

* You must clearly and concisely **state** the expected achievements (**goals**) of the planned research or the developed software, in a specific manner – that will allow their verification upon completion of the project.

Note: This section is intended to be **short** – just a few lines, relating to the challenges and the planned work and goals. It is **not** intended to serve as an introduction of the project, including background etc.

**In current days not all countries have expensive medical equipment capable of creating high resolution & noise-free medical images. furthermore, to create such images the patient needs to be exposed to high-power radiation which can cause medical risks.**

**This project's goal is to create a network capable of denoising lower quality images without losing medical needed data, so even poor countries can benefit from good medical care and without exposing the patients to unnecessary risks.**

**In addition, the use of "clean" images to teach our network is difficult because "clean" images are hard to get by. On the opposite, "noisy" images are more commonly found, so we decided to use the Noise-to-Noise algorithm which uses pair of "noisy" images to teach the network, with the same results and sometimes even better than Noise-to-Clean.**

**Scope of the project:**

*Please* specify in a few lines the nature and scope of the project, including (but not limited to):

* The characteristics of the project and the expected work done by the students,
* What is included the preparation phase,
* Which methodologies or technologies might be used, indication of a computational algorithm or technological challenges included.

As part of this description you must clearly specify:

* which areas of knowledge are related to this project,
* what is the nature of research included in this project (knowledge areas, direction),
* what are the product and outcome of the project. This particularly refers to artifacts **created** as part of the project work – in order to emphasize them and distinguish from the work done by means of existing environments or methodologies.

**This project includes research of different networks for an optimal solution to the problem of denoising.**

**In the preparation phase, we intend to find researches that will help us decide which networks, which loss functions, and which data is best suitable for the problem.**

* **We will use the Noise-to-Noise algorithm using a neural network,**
* **with the "DeepLesion" dataset that contains 32,735 CT images.**

**This project uses Deep learning networks to accomplish all the above.**

**Unique features:**

In this section

*Please* describe some **specific** unique **features** of the system to be developed or the research to be performed, or of the research/development method/process itself, which make this project having adequate or great merit, character, or value.

Note: This section is about specific features of the product of the project – the research or the developed system. No need to list the students' learning challenges or goals.

**As mentioned above, the unique feature of the research is the usage of only "noisy" images to train the network instead of getting a pair of "noisy"-"clean" images.**

Note:

Avoid refering anywhere in this prospectus to the costraints/challenges relating to the 'hardships of the project', e.g.: limited time, working on the project in parallel with other courses, lack of knowledge or experience in related topics/domains, the general need to gather information and/or learn new things, communication difficultues, etc.

These type of issues are known and common challenges, thus considered trivial (i.e. typical, "regular" - not to be confused with: insignificant, "require little effort"). Most if not all students in every project have to face and overcome these challenges. Also, the need to learn new "topics/approaches/methods/techniques" or technologies is an inherent challenge/goal of the Capstone Project, as well as coping with time constraints - which are typical to any research or software development effort.

In the prospectus (as well as in the semesterial project report ("book") you need to point out and refer to core challenges pertaining to the specific scientific and technological aspects of your project. In that respect refrain fro using generic terms e.g. "Deep Learning algorithm", etc.