Computer Science PHD

Research project for a PhD curriculum in Computer Science

**Tutor**: Laura Leal-Taixe

**(\*) [eventual Industrial] Co-tutor:** Rita Cucchiara

**(\*\*) Foreign Co-tutor:**

**Proposed Title of the research:**

4D reconstruction and perception

**Keywords:**

Gaussian splatting, video analysis, graph neural networks, video object segmentation, neural reconstruction

**Research objectives: --(max 10 rows)**

The objective of this research is to study the synergies between reconstruction methods such as Gaussian splatting or neural reconstruction fields (NeRF) and perception, i.e., semantics. The idea is not only to reconstruct the 3D geometry of an observed scene, but also to understand the content at the time of reconstruction. The interplay between the two tasks should make both of them easier, i.e., having the prior of reconstruction a car makes the reconstruction task easier.

The objectives will be to: (i) study the interplay between reconstruction and perception, (ii) propose a methods to perform both simultaneously, (iii) simplify dynamic scene reconstruction by using semantics.

**Proposed research activity -- (max 10 rows)**

We will start by simplifying the dynamic scene reconstruction looking only at how we can perform multi-object tracking by using reconstruction losses. The scene and the tracking problem will be represented by a scene graph. This will allow us to see first signs of how reconstruction and perception interact with each other.

We will then move towards attaching full semantics to reconstruction and constraining the reconstruction to such semantics.

**Supporting research projects (and Department) Department of Engineering Enzo Ferrari**

**Possible connections with research groups, companies, universities.**

The PhD will be done at NVIDIA Italy.

(\*) optional

(\*\*) optional/to be completed on the second year