Phd: Piecewise Smooth Surface Reconstruction from Characteristic Features

While reconstruction of smooth surfaces from point sets has received a considerable amount of efforts in the past twenty years, adding the piecewise property to the topic is enough to narrow the number of publications by at least an order of magnitude. We can further narrow the taxonomy by distinguishing the work which assume that the features have been detected and aim at preserving them, from the ones which recover the features during reconstruction without having to extract them apriori. One more step in the narrowing of the previous work can be made by listing the techniques able to achieve piecewise smooth reconstruction from sparse and noisy data sets.

Of course, several techniques for post-processing (smoothing or fairing) the reconstructed surface while preserving the features (be they tagged or inferred) exist, but we aim at conceiving a reconstruction algorithm which would achieve both feature detection and reconstruction altogether. This issue becomes even more challenging when the input data set is entangled with noise. Furthermore, the feature detection and reconstruction process should take into into account both the scale of the final reconstructed scene and the targeted budget for the size of the output mesh. Beside the piecewise property of the targeted reconstruction technique and the nature of the input data (characteristic points and higher level features), this PhD topic contains another innovative aspect: We wish to investigate the possibility to incorporate in the reconstruction process a shape recovery procedure (inspired from 1) applied both to surface and feature areas in order to obtain a surface where the initial canonical parts are preserved. The latter procedure can be seen as a fairing process, which we see as one step further than denoising.

This PhD subject is strongly related to an ANR project, called Gyroviz, whose goal is to produce automatic reconstruction of outdoors scenes, typically scenes from cities, from sequences of digital images. In this project, the camera will be equipped with motion and rotational tracking systems and the resulting information will be used to make faster the stereo vision processing of the images. The subject of this PhD thesis adresses the next step in the reconstruction pipeline, where the set of 3D points, outcome from the stereo vision processing of images, must be turn into mesh that is a pertinent and accurate representation of the scene.