Title of research:

Research Capacity in Topology based Image Segmentation (TObIS)

Objectives:

- To identify key insights gained by Topological Data Analysis (TDA) in the image segmentation area, and its application to real world use case.
- Developing a knowledge base in TDA in BMW.
- Developing a Python based library for TDA tasks.

Please give a brief justification of your proposed research project:

The aim of this research proposal is to develop and implement an improved image segmentation method using TDA that could be used further in applications involving detection, recognition and measurement of objects in images.

The role of segmentation is crucial in most tasks requiring image analysis. The success or failure of the task is often a direct consequence of the success or failure of segmentation. However, a reliable and accurate segmentation of an image is, in general, very difficult to achieve by purely automatic means. The proposal here is to investigate the quality of image segmentation via TDA.

Domains of application that can benefit:
• Industrial inspection (in Production)
• Tracking of objects in a sequence of images (in autonomous driving)
• Classification of terrains (in mobility)

The hope of this research project would be:

- To develop a Library (in Python preferably) which BMW data scientist can use out of the box to apply image segmentation.
- To apply TDA based image segmentation to autonomous driving related drive images.

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2. Herbert Edelsbrunner and John Harer, "*Computational Topology – an Introduction*", AMS 2010.

3. Julien Tierny, Guillaume Favelier, Joshua Aaron Levine, Charles Gueunet, Michael Michaux, "The Topology ToolKit", IEEE Transactions on Visualization and Computer Graphics (Proc. Of IEEE VIS 2017). http://topology-tool-kit.github.io

4. Sylvain Paris, Frédo Durand, "*A Topological Approach to Hierarchical Segmentation using Mean Shift*", Proc. Of IEEE CVPR 2007