

| Code: <b>MSR-06-TSDC</b>                       |  |                      |                             |                      |                              |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
|--|--|----------------------|-----------------------------|----------------------|------------------------------|---|--------------|-------------------------------------|--|----------------------------------|--------|----|-------|----|---|---------------------|----------------------------------|----|----|---|----|---|---------|----------------------------------|----|----|---|----|---|
| Title: <b>Techniques for Self-Driving Cars</b> |  |                      |                             |                      |                              |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| <b>1</b>                                       | <p><b>Content and intended learning outcomes</b></p> <p>Content:<br/>         Introduction to self-driving cars and current challenges; detection of driving-related entities; PD and model-predictive control for steering autonomous vehicles; path planning and obstacle avoidance; self-driving car simulation; software infrastructure in self-driving vehicles</p> <p>Qualification goals:<br/>         Understanding central building blocks and underlying methods for perception and control of self-driving cars; Ability to read, understand, review, and present scientific publications; Ability to successfully plan and execute small projects that include implementing and evaluating existing/already published approaches for self-driving cars in Python</p> |                      |                             |                      |                              |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| <b>2</b>                                       | <p><b>Teaching and learning methods</b></p> <table border="1"> <thead> <tr> <th>Type</th> <th>Topic</th> <th>Language</th> <th>Group-size</th> <th>SWS</th> <th>Work-load</th> <th>Term</th> </tr> </thead> <tbody> <tr> <td>Lecture</td> <td>Techniques for Self-Driving Cars</td> <td>en</td> <td>20</td> <td>1</td> <td>45</td> <td>W</td> </tr> <tr> <td>Exercise, practical</td> <td>Techniques for Self-Driving Cars</td> <td>en</td> <td>20</td> <td>2</td> <td>75</td> <td>W</td> </tr> <tr> <td>Seminar</td> <td>Techniques for Self-Driving Cars</td> <td>en</td> <td>20</td> <td>1</td> <td>60</td> <td>W</td> </tr> </tbody> </table>  | Type                 | Topic                       | Language             | Group-size                   | SWS   | Work-load    | Term                                | Lecture  | Techniques for Self-Driving Cars | en     | 20 | 1     | 45 | W | Exercise, practical | Techniques for Self-Driving Cars | en | 20 | 2 | 75 | W | Seminar | Techniques for Self-Driving Cars | en | 20 | 1 | 60 | W |
| Type   | Topic  | Language             | Group-size                  | SWS                  | Work-load                    | Term  |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| Lecture  | Techniques for Self-Driving Cars   | en                   | 20                          | 1                    | 45                           | W   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| Exercise, practical                            | Techniques for Self-Driving Cars   | en                   | 20                          | 2                    | 75                           | W   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| Seminar  | Techniques for Self-Driving Cars   | en                   | 20                          | 1                    | 60                           | W   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| <b>3</b>                                       | <p><b>Prerequisites to take part the module</b></p> <p>obligatory:<br/>         Sensors and State Estimation (MSR-01) and Advanced Techniques for Mobile Sensing and Robotics (MSR-02)<br/>         OR Photogrammetry I&amp;II (B36) and Photogrammetry &amp; GIS (M23)</p> <p>recommended:<br/>         Python programming capabilities<br/>         Machine Learning (e.g., through MSR-06-MLROB: Machine Learning for Robotics &amp; Computer Vision or a similar course)</p>   |                      |                             |                      |                              |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| <b>4</b>                                       | <p><b>Study program allocation</b></p> <table border="1"> <thead> <tr> <th>Study program</th> <th>mandatory / elective module</th> <th>recommended semester</th> </tr> </thead> <tbody> <tr> <td>Geodetic Engineering (M.Sc.)</td> <td>Elective selection: Study profile 'Mobile Sensing and Robotics'</td> <td>3rd semester</td> </tr> <tr> <td>Geodäsie und Geoinformation (M.Sc.)</td> <td>Fachgebundener Wahlpflichtbereich: Wahlpflichtmodul "groß"</td> <td>3. Fachsemester</td> </tr> </tbody> </table>   | Study program        | mandatory / elective module | recommended semester | Geodetic Engineering (M.Sc.) | Elective selection: Study profile 'Mobile Sensing and Robotics' | 3rd semester | Geodäsie und Geoinformation (M.Sc.) | Fachgebundener Wahlpflichtbereich: Wahlpflichtmodul "groß"                           | 3. Fachsemester                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| Study program                                  | mandatory / elective module  | recommended semester |                             |                      |                              |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| Geodetic Engineering (M.Sc.)                   | Elective selection: Study profile 'Mobile Sensing and Robotics'  | 3rd semester         |                             |                      |                              |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| Geodäsie und Geoinformation (M.Sc.)            | Fachgebundener Wahlpflichtbereich: Wahlpflichtmodul "groß"   | 3. Fachsemester      |                             |                      |                              |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| <b>5</b>                                       | <p><b>Requirements for the rewarding of credits (ECTS)</b></p> <p>Examination(s):</p> <table border="1"> <thead> <tr> <th>Type</th> <th>Prerequisites</th> <th>Duration</th> <th>graded/ not graded</th> <th>Language</th> <th>Weight</th> </tr> </thead> <tbody> <tr> <td>Oral examination</td> <td>written (exercises, practical) and verbal (seminar) academic performance during term</td> <td>25</td> <td>graded</td> <td>en</td> <td>100 %</td> </tr> </tbody> </table>  | Type                 | Prerequisites               | Duration             | graded/ not graded           | Language  | Weight       | Oral examination                    | written (exercises, practical) and verbal (seminar) academic performance during term | 25                               | graded | en | 100 % |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| Type   | Prerequisites  | Duration             | graded/ not graded          | Language             | Weight                       |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| Oral examination                               | written (exercises, practical) and verbal (seminar) academic performance during term   | 25                   | graded                      | en                   | 100 %                        |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| <b>6</b>                                       | <p><b>Credits according ECTS</b></p> <p>6 LP</p>   |                      |                             |                      |                              |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| <b>7</b>                                       | <p><b>Workload</b></p> <p>180 h</p>  |                      |                             |                      |                              |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |
| <b>8</b>                                       | <p><b>Duration</b></p> <p>1 semester</p>   |                      |                             |                      |                              |   |              |                                     |  |                                  |        |    |       |    |   |                     |                                  |    |    |   |    |   |         |                                  |    |    |   |    |   |

| 9                                  | <b>Frequency</b><br>winter term   |      |              |      |      |      |                                    |  |   |   |   |                         |  |   |   |  |
|------------------------------------|---|------|--------------|------|------|------|------------------------------------|--|---|---|---|-------------------------|--|---|---|--|
| 10                                 | <b>Maximum number of students</b><br>no limitation  |      |              |      |      |      |                                    |  |   |   |   |                         |  |   |   |  |
| 11                                 | <b>Module coordination</b><br>Lecturer: <table border="1" data-bbox="193 338 1469 456"> <thead> <tr> <th>Name</th> <th>Organisation</th> <th>SWS</th> <th>exe.</th> <th>res.</th> </tr> </thead> <tbody> <tr> <td>Prof. Dr.rer.nat. Cyrill Stachniss</td> <td>Institut für Geodäsie und Geoinformation</td> <td>1</td> <td>X</td> <td>X</td> </tr> <tr> <td>Dr.rer.nat. Jens Behley</td> <td>Institut für Geodäsie und Geoinformation</td> <td>3</td> <td>X</td> <td></td> </tr> </tbody> </table><br>Module coordinator / Organisation:<br>Prof. Dr.rer.nat. C. Stachniss (Institut für Geodäsie und Geoinformation) | Name | Organisation | SWS  | exe. | res. | Prof. Dr.rer.nat. Cyrill Stachniss | Institut für Geodäsie und Geoinformation | 1 | X | X | Dr.rer.nat. Jens Behley | Institut für Geodäsie und Geoinformation | 3 | X |  |
| Name                               | Organisation  | SWS  | exe.         | res. |      |      |                                    |  |   |   |   |                         |  |   |   |  |
| Prof. Dr.rer.nat. Cyrill Stachniss | Institut für Geodäsie und Geoinformation  | 1    | X            | X    |      |      |                                    |  |   |   |   |                         |  |   |   |  |
| Dr.rer.nat. Jens Behley            | Institut für Geodäsie und Geoinformation  | 3    | X            |      |      |      |                                    |  |   |   |   |                         |  |   |   |  |
| 12                                 | <b>Further information</b><br>None  |      |              |      |      |      |                                    |  |   |   |   |                         |  |   |   |  |
| 13                                 | <b>Date of version</b><br>01.10.2022  |      |              |      |      |      |                                    |  |   |   |   |                         |  |   |   |  |