路面平整度 – 理论与实践 Pavement Smoothness – Theory And Practices

课程简介及目标 Introduction to the Course and Objectives

路面平整度是所有类型的路面（沥青，混凝土，复合）的唯一共同的检测指标。路面平整度比其他路面病害检测技术（如表面车辙，开裂，剥落）技术成熟。从路面平整度检测设备的技术认证，数据采集，数据分析和报告，到路面工程验收标准，路面平整度已经非常完善。

Pavement smoothness is the only common test indicator for all types of pavement (asphalt, concrete, composite). Pavement smoothness technology is more mature than other pavement distresses detection techniques (such as rutting, cracking, and raveling). From the technical certification of road surface roughness testing equipment, data collection, data analysis and reporting, to pavement engineering acceptance standards, pavement smoothness has been complete.

这门课将含盖路面平整度的各个方面的理论与实践，包括：路面材料与结构，路面施工，路面检测机械，数据采集及处理的电子技术，车辆与路面的互动反应，路面波型分析，实际路面平整度数据分析软件在公路及机场跑道的应用，等等。上完这门课的学生将对路面平整度有深刻的了解，并学习多学科，多领域的研究及克服问题的创新方法。

This course will cover the theory and practice of all aspects of pavement smoothness, including: pavement materials and structures, pavement construction, pavement inspection machinery, electronic technology for data acquisition and processing, interaction between vehicles and road surfaces, and analysis of road surface waveforms. , the application of road surface roughness data analysis software in highways and airport runways, and so on. Students who complete this course will have a deep understanding of the smoothness of the road and multi-disciplinary research and innovative ways to overcome problems.

教授简介 Introduction to the Lecturer

教授此课程的张国能博士（Dr. George K. Chang）是世界知名的路面平整度专家，他有关路面平整度的资历包括：Dr. George K. Chang, who teaches this course, is a world-renowned expert on pavement smoothness. His smoothness-related qualifications include following:

- 国际智能建设科技学会主席 （IICTG, 2016 至今）Chairman of the International Intelligent Construction Technologies Group (IICTG, 2016-present)
- 国际路面平整度学会主席（Road Profile Users Group – RPUG，2010 至 2011) Chairman of the Road Profile Users Group (RPUG, 2010 to 2011)
- 美国交通运输研究委员会-路面与车辆互动委员会主席(TRB AFD90， 2012 至 2018) Chairman of the US Transportation Research Board – Pavement Surface and Vehicle Interaction Committee (TRB AFD90, 2012 to 2018)

- 美国交通运输研究委员会-路面与车辆互动委员会终身名誉会员-Emeritus Member(TRB AFD90， 2019+) Emeritus Member of the US Transportation Research Board – Pavement Surface and Vehicle Interaction Committee (TRB AFD90, 2019+)
- 美国测试与材料标准学会-路面平整度测试次委员会主席（ASTM E-17.31， 2004 至今） Chairman of the ASTM International – Pavement Profile Measurements subcommittee (ASTM E-17.31， 2004-present)
- 国际路面平整度标准软件（ProVAL）的开发领导 (2001 至今) Team lead for international pavement smoothness standard – Profile Viewing and Analysis (ProVAL) software (2001-present)
- 国际及美国路面平整度规范的的开发领导（ASTM 及 AASHTO）Team lead for pavement smoothness-related standards and specifications for ASTM and AASHTO.
- 在国际及美国教授路面平整度训练课程已过 17 年 Lecturer for international and US Pavement Smoothness training workshops for more than 17 years.

张博士的课程讲授语言将包括中文及英文。鼓励学生阅读英文文献，用英文讨论及发表论文，以为将来与世界学术科技交流做准备。Dr. Chang's course language will include both Chinese and English, encouraging students to read English literature, discuss and publish papers in English, and prepare for future academic and scientific exchanges with the world.

先修课程及预读文献 Prerequisites and Pre-Course Literature Reading Assignment

- 路面工程/材料/结构/施工的概念 Pavement engineering / material / structure / construction concept
- 预读《路面平整度基础概论（Little Book of Profiling）》（英文）Read-ahead "Little Book of Profiling" (English)
- 下载国际路面平整度 ProVAL 最新版软件 （www.RoadProfile.com ）。装置的电脑操作系统须是 Windows7 以上，以及 Microsoft .NET 4.5.2，安装软件时会自动从网上下载及安装。Download the latest version of the international pavement smoothness ProVAL software (www.RoadProfile.com). The computer operating system of the device must be Windows 7 or higher, and Microsoft .NET 4.5.2 is required which will be automatically downloaded from the web and installed when the software is installed.

其他课程要求 Other Course Requirements

- 在课程中，学生需使用笔记型电脑，并装制国际路面平整度 ProVAL 软件做数据分析。In the course, students need to use notebook computer 是 and install the international pavement smoothness ProVAL software for data analysis.
- 每日上完课后，老师会将当日课程的 PPT，以 PDF 在课程的微信群中发布。After the class is finished every day, the teacher will publish the PPT of the current day's course in PDF on the WeChat group of the course.
- 学生可从上过的课程范围或相关领域中自选论文题目。可用中文或英文。Students can choose their own thesis topics from the scope of the course or the relevant fields in Chinese or English.

- 学生论文口头报告将在课程最后一天举行，每人约 20 分钟，可用 PPT。The oral presentation of the student papers will be held on the last day of the course, approximately 20 minutes per person, with PPT as an option.
- 书面论文在课程后两周内提交，每份 5 至 10 页，以 Microsoft Word 的格式电邮寄至 GKChang@TheTranstecGroup.com。Written papers are submitted in in Microsoft Word format within two weeks after the last day of the course, 5 to 10 pages each, and email them to GKChang@TheTranstecGroup.com.
- 学生论文口头报告和书面论文各占学期成绩的 50%。Student paper oral reports and written papers each account for 50% of the semester's grade.

课程大纲 Course Outline

第 1 单元: 路面平整度基础 Unit 1: Fundamentals of Smoothnesss

1.1 路面平整度基础概论 Basics of Pavement Smoothness

1.2 路面平整度测试技术 Testing Techniques for Pavement Smoothness

1.3 路面平整度的数据分析及乘坐质量–基础课 Data Analysis and Ride Quality Evaluation of Pavement Smoothness

第 2 单元: 路面平整度的分析 Unit 2: Smoothness Analysis

2.1 路面平整度 PSD 波长分析 Power Spectral Density - PSD

2.2 路面平整度波长过滤 Profile Wavelength Filtering

2.3 路面平整度关键的精度要求 Critical accuracy Requirements of Profiling

2.4 用较互相关的分析作路面平整度的数据比较及在路面平整度检测设备的认证 Cross correlation for Profile Comparison and Profiler Certification

第 3 单元：路面平整度的应用 Unit 3: Application of Pavement Smoothness

3.1 利用路面施工质量管理来改善漓青路面平整度 Construction QC for Improving Asphalt Pavement Smoothness

3.2 利用路面施工质量管理来改善刚性路面平整度 Construction QC for Improving Concrete Pavement Smoothness

3.3 利用路面研磨技术来改善路面及桥面平整度 Grinding for Improving Pavement and Bridge Deck Smoothness

3.4 路面平整度规范 Smoothness specifications

3.5 节段混凝土路面卷曲型变及路面平整度的关系 Curling and Warping of Jointed Concrete Pavements (JCP) vs. Smoothness

3.6 机场跑道的平整度 Airport Runway Smoothness

3.7 车载测试的路面平整度必要条件 Smoothness Requirements for Weight-In-Motion (WIM) Sites

第 4 单元: ：与路面平整度相关的应用 Unit 4: Smoothness-Related Topics and Applications

4.1 路面纹理测量 Pavement Surface Textures Measurements

4.2 用路面平整度的数据估计节段混凝土路面接缝垂直沉陷
Automated Fault Measurements of JCP using Profiles

4.3 路面的检测的三维激光及其他新技术 3D Laser Scanning and Other New Technologies for Pavement Surface Survey

4.4 中国美国及国际路面平整度的现况 State of Practices in China, US and Other Countries

授课日程表 Class Schedule

次数 No.	单元 Unit	长度（小时）Duration (hours)
1	1.1	1.0
2	1.2	1.0
3	1.3	1.0
4	软件分析及讨论 Software analysis exercise and discussion	2.0
5	2.1	1.0
6	2.2	1.0
7	2.3	1.0
8	2.4	1.0
9	软件分析及讨论 Software analysis exercise and discussion	2.0
10	3.1	1.0
11	3.2	1.0
12	3.3	1.0
13	3.4	1.0
14	软件分析及讨论 Software analysis exercise and discussion	2.0
15	3.5	1.0
16	3.6	1.0
17	3.7	1.0
19	软件分析及讨论 Software analysis exercise and discussion	2.0
20	4.1	1.0
21	4.2	1.0
22	4.3	1.0
23	4.4	1.0
24	学生论文发表 Term paper presentation by students	4.0
	总时数	**30**