EASA
European Union Aviation Safety Agency

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RWYMT (RUNWAY MICRO TEXTURE) [EASA.2022.C06]

Specifications of high-resolution laser scanners D-4.3

An Agency of the European Union

Disclaimer

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SUMMARY

As part of the EASA Runway Micro Texture project a method is being developed to identify when a runway surface could be defined as slippery wet. This method uses high resolution surface scans to analyse the micro texture characteristics of the runway surface. The current report describes the work done as part of work package 4.3. Minimum specifications and operational procedures for a high-resolution laser scanner are presented based on the working experience gained with the scanner used in the research project.

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ABBREVIATIONS

ACRONYM	DESCRIPTION
ASTM	American Society for Testing and Materials
EASA	European Union Aviation Safety Agency
ESDU	Engineering Sciences Data Unit
NLR	Nationaal Lucht- en Ruimtevaartlaboratorium (National Aerospace Center)

1. Introduction

1.1 Background

NLR, and its partners DLR and ESDU are conducting a research project for EASA, called the EASA Runway Micro Texture Project, to develop a new method to determine when a runway maybe slippery when it is wet. This project is funded from the European Union's Horizon Europe research and innovation programme. As part of the EASA Runway Micro Texture Project several tests have been conducted. These tests encompassed braked tests with different aircraft on wetted runway sections and surface pavement measurements using different devices. Braking friction data derived from the flight tests and results from British Pendulum tests have been converted into a micro texture sharpness parameter. Results obtained with high resolution surface lasers scanners have been used to derive several micro texture parameters that have been correlated with the micro texture sharpness parameter. These results can be used to develop a methodology to assess slippery wet runways.

The present report is deliverable D-4.3 of work package 4. It describes minimum specifications and operational procedures for the use of a high-resolution laser scanner.

1.2 Objectives

This report is deliverable D-4.3 of the EASA Runway Micro Texture Project (EASA.2022.C06). The work presented here is the output from work package 4. The objective is to develop minimum specifications and operational procedures for a high-resolution laser scanner based on the working experience gained with the scanner used in the research project.

2. Basic specifics for assessing micro texture characteristics of a runway surface

2.1 Introduction

The World Road Association has established standard categories of texture, classified by wavelength. These categories include micro texture (wavelengths up to 0.5 mm), macro texture (0.5 to 50 mm), mega texture (50 to 500 mm), and roughness (wavelengths larger than 500 mm). Texture wavelength is a quantity describing the horizontal dimension of the irregularities of a texture profil (ISO/DIS 13473-1). The wavelengths and the amplitude for micro texture determine the requirements for a surface scanner or any other device that measures surfaces profiles.

2.2 Surface laser scanner specification

The specifications for the surface laser scanner are based on the device used in the research study. These specifications could serve as a starting point when selecting a surface scanning device to be used in the measurement of micro texture characteristics of runways. In particular the vertical and length resolution are of importance in order to capture the micro texture characteristics of the surface. The width resolution defines how many scan lines can be made. The following specifications are given for the surface laser scanner used in the research study:

- Vertical Resolution: 0.003 mm
- Maximum Length Resolution: 0.00635 mm
- Maximum Width Resolution: 0.0247 mm
- Triangulation Angle at center of range: 22°
- Dot size at center of range: 25 um
- Dot size at Max and Min range: 60 um

2.3 Scan area

Surface laser scanners use a laser sensor to scan the surface coordinates of parallel straight lines. The length of one line should be at least 100 mm. An area with a width of at least 70 mm should be scanned. It is recommended to use 15 scanlines as a minimum over a width of 70 mm. More lines could improve the results however at the cost of more time to performed one spot measurement.

2.4 Operational conditions

The operational conditions under which laser surface scans should be made are based on the experiences gained in the research study as well as those specified by the manufacture of the device used in the study. These are as follows:

- The surface measurements shall not be made during rain or snow fall or on surfaces that are covered by water, snow, ice etc. This will affect the results obtained with the surface scanner.

- Measurements should not be conducted at temperatures outside the specified range set by the manufacturer because the internal mechanism of the surface laser scanner can be affected by the ambient conditions, especially air temperature.
- Direct sunlight will cause spikes to occur in the data. When sunlight is directly striking the surface that is to be scanned, a shield to block direct sunlight on the scanning surface should be used. Alternatively, the laser scanner could be covered by a box.
- For very dark coloured surfaces, or for scanning outside in the sunlight it is best to use the full power setting of the laser device.

2.5 Output of the laser surface scanner

The device should be able to export the results to text files which can be processed by the user with dedicated software. Alternatively, the manufacturer could implement algorithms into the memory of the device to process the results immediately after the spot measurements.

2.6 Amount of Data Required

As the surface laser scanner is a stationary device, a continuous measurement is not possible. Therefore, measurements have to be made at certain spots which are appropriately distributed on the runway. The texture of the runway pavement that has been in service can vary across runway due to normal wear. In this case the transverse location of the measurements should be determined by the expected location of the main gear tires of the aircraft that frequently use the runway. Also along the runway, differences could exist in the texture due e.g. rubber buildup and wear. Uniform test sections along the runway should therefore be identified. For a uniform test section, it is sufficient to obtain 16 evenly spaced profiles regardless of test section length following the guidelines given in ASTM E1845 – 09[1]. When characterising a long section with relatively short sample lengths, it is important to ensure that the texture is sufficiently homogeneous to provide a representative measure. To characterise a nonhomogeneous pavement sound judgement is necessary from the user. Aerial surveys using a drone could be of assistance to identify differences in the surface and also to the areas with rubber deposits.

[1] ASTM E1845-09, Standard Practice for Calculating Pavement Macrotexture Mean Profile Depth, Jun 12, 2015.

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