EUROPEAN PAVEMENT FRICTION WORKSHOP – 23 MAY 2019

RUNWAY WEATHER INFORMATION SYSTEMS

State of the art and main issues for standardization

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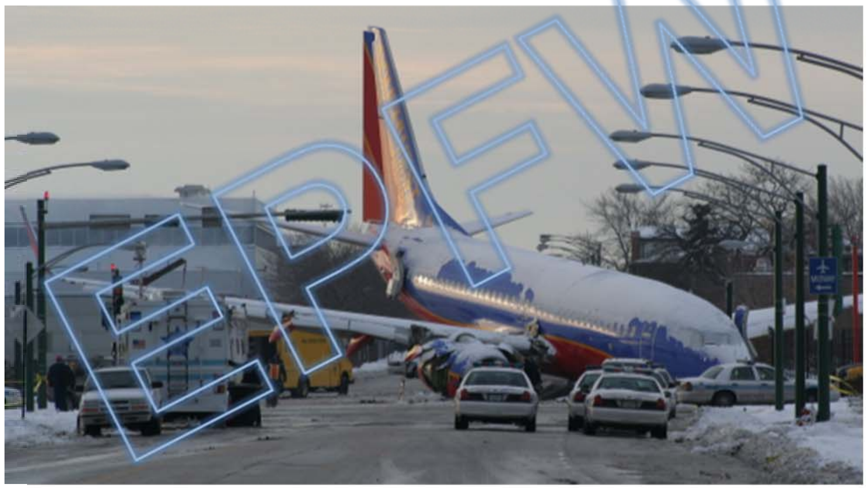
2 BACKGROUND

- **Challenge: prevent runway excursions at landing and take-off**



A319/A320/A321 | QATAR AIRWAYS | IN FLIGHT PERFORMANCE | REV 36 | SEQ 230 | 4.04

AUTOLAND LANDING DISTANCE WITH AUTOBRAKE

CONFIGURATION FULL

ACTUAL LANDING DISTANCE (METERS)								
WEIGHT (1000 KG)			54	62	70	78	86	94
RUNWAY CONDITION		MODE						
DRY		MED	1280	1370	1460	1530	1660	1800
		LOW	1830	1990	2150	2300	2450	2590
WET		MED	1330	1440	1560	1670	1820	1980
		LOW	1830	1990	2150	2300	2450	2590
C	6.3 MM (1/4 INCH)	MED	1660	1830	2020	2190	2400	2580
O	WATER	LOW	1810	1980	2150	2310	2490	2660
V	12.7 MM (1/2 INCH)	MED	1590	1760	1920	2080	2250	2430
E	WATER	LOW	1790	1960	2120	2270	2430	2590
R	6.3 MM (1/4 INCH)	MED	1590	1760	1940	2080	2270	2440
E	SLUSH	LOW	1770	1930	2080	2220	2380	2540
D	12.7 MM (1/2 INCH)	MED	1540	1690	1850	2000	2160	2310
	SLUSH	LOW	1760	1910	2070	2210	2350	2500
W	COMPACTED	MED	1500	1600	1710	1800	1890	1970
I	SNOW	LOW	1780	1940	2090	2230	2380	2520
T	ICE	MED	2790	3030	3270	3490	3720	3940
H		LOW	2810	3050	3290	3510	3740	3960

+ 5-10%

+ 30-45%

+ 120%

THE GLOBAL REPORTING FORMAT (GRF)

- **Challenge: prevent runway excursions at landing and take-off**
- **Objective: reliable, standardized assessments of the runway surface condition**
  - ➢ Contamination type
  - ➢ Contamination depth
  - ➢ Coverage
  - ➢ Aircraft braking action
- A new, worldwide ICAO regulation starting from November 2020

Runway condition assessment matrix (RCAM)

Assessment criteria		Downgrade assessment criteria	
Runway condition code	**Runway surface description**	**Aeroplane deceleration or directional control observation**	**Pilot report of runway braking action**
6	• DRY	---	---
5	• FROST • WET (The runway surface is covered by any visible dampness or water up to and including 3 mm depth) *Up to and including 3 mm depth:* • SLUSH • DRY SNOW • WET SNOW	Braking deceleration is normal for the wheel braking effort applied AND directional control is normal.	GOOD
4	***−15°C and Lower outside air temperature:*** • COMPACTED SNOW	Braking deceleration OR directional control is between Good and Medium.	GOOD TO MEDIUM
3	• WET ("slippery wet" runway) • DRY SNOW or WET SNOW (any depth) ON TOP OF COMPACTED SNOW ***More than 3 mm depth:*** • DRY SNOW • WET SNOW ***Higher than −15°C outside air temperature[1]:*** • COMPACTED SNOW	Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced.	MEDIUM
2	***More than 3 mm depth of water or slush:*** • STANDING WATER • SLUSH	Braking deceleration OR directional control is between Medium and Poor.	MEDIUM TO POOR
1	• ICE [2]	Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced.	POOR
0	• WET ICE [2] • WATER ON TOP OF COMPACTED SNOW [2] • DRY SNOW or WET SNOW ON TOP OF ICE [2]	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain.	LESS THAN POOR

Runway Surface Condition Assessments

- **Today:**

  - ➢ Visual inspections, ruler measurements

  - ➢ 30’ runway closure to assess runway surface condition

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RUNWAY SURFACE CONDITION ASSESSMENTS

- **Tomorrow ?**

  - Mobile sensors
  - Embedded sensors
  - Aircraft data
  - Algorithms

- **Automatic reliable assessments**

ROAD SENSORS: STATE OF THE ART

- **In 2017, STAC studied weather contamination sensors:**
  - In lab and on-site tests of 3 mobile sensors
  - In lab tests of 2 embedded sensors

ROAD SENSORS: STATE OF THE ART

- **Main conclusions**
  - No sensor could discriminate between 8 contaminants
  - Embedded sensors have a too long response time (about 40’) for operational use
  - Mobile sensors are not accurate and repeatable enough for airport use
  - Water depth assessments are strongly affected by chemical treatment

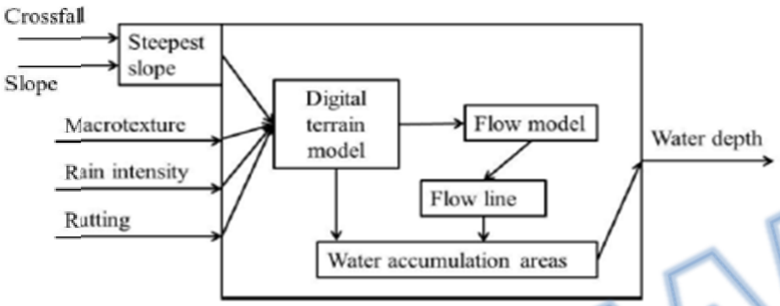
SPACE AND TIME COVERAGE

- **One of the most important issues**
  - Continuous reliable assessment of a runway for each runway third
  - Continuous but localized measurement (embedded sensors) + one-time but track measurements (mobile sensors) + air traffic related measurement (aircraft data)

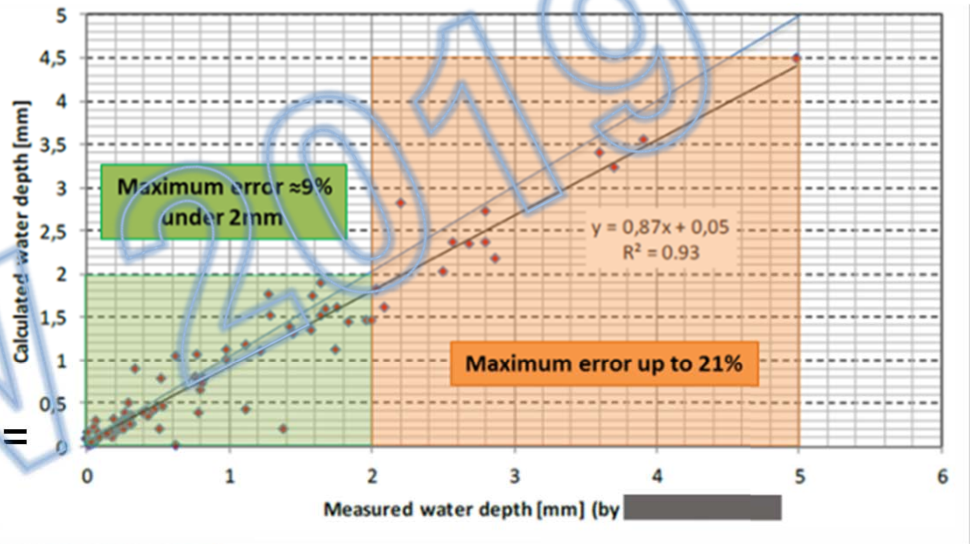
- **Combination of various systems ?**
  - Sensors
  - Physical models
  - Optical evaluations
  - Artificial intelligence

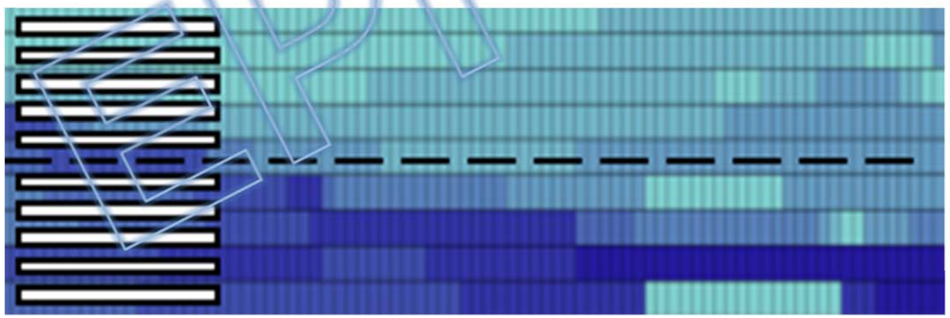
SPACE AND TIME COVERAGE

- **Example: OPHELIA**



Rainfall predictions + terrain models = water accumulations assessment





Test campaigns at LFLL (Lyon) airport

STANDARDIZATION

- **Objectives**
  - ➢ Understand airport needs to be sure that standards are relevant
  - ➢ Determine technical limitations of current technologies
  - ➢ Make sure that systems reach minimum level of performance

- **Standardization efforts**

WG-109 RWIS (chaired by STAC) ⟷ *E-17 Vehicle/Pavement Systems*

EUROCAE

ASTM INTERNATIONAL
Standards Worldwide

STANDARDIZATION

- **Main topics**

  - Common **terminology**
    - Between different technologies
    - Between human operators and technologies

  - **Use cases and performance requirements**, depending on:
    - Climate conditions
    - Airports needs and uses
    - Facility of runway closure

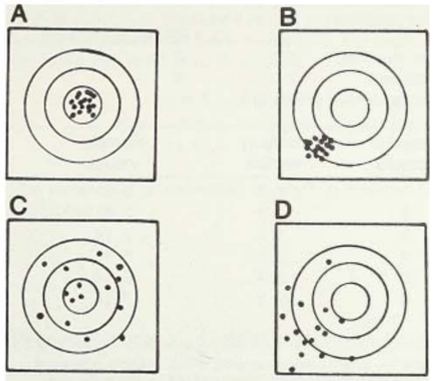


Figure 1.—The bullseye analogy. Various patterns of darts at a target: **(A)** high precision, low bias, high accuracy; **(B)** high precision, high bias, medium accuracy; **(C)** low precision, low bias, low accuracy; and **(D)** low precision, high bias, lowest accuracy.

  - **Performance assessments procedures**
    - Repeatability, accuracy
    - Reference contamination and reference values

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STANDARDIZATION

- **Key stakeholders**
  - Airport operators
  - Airlines
  - Aircraft manufacturers
  - Pilots
  - Sensors manufacturers
  - Systems integrators
  - Civil aviation authorities


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