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ESTEP ANNUAL EVENT 2023

3 - 5 October |
Barcelona

A CIRCULAR
ECONOMY DRIVEN
by the European Steel

Increasing the recycling of scrap and scrap processing residues

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Data Science Director
Tenova S.p.A.

Lighthouse Project – Tenova and Ori Martin



Location: Brescia, Italy
Customer: Ori Martin
Funding: Italian Ministry of Economic Development
 Regione Lombardia
Started: 2019



- Automatic **classification of scrap material** entering the plant by truck
- System for **identification of bulky material** on the Consteel®
- Estimation of the **level of tramp elements** present in each material
- Automatic **profiling of the volumes of scrap** material in the storage area
- System for **weighing scrap material** transported by the crane
- Automatic scrap **classification of scrap material** entering the furnace



Automatic classification of incoming scrap



Sheet 50



Sheet PS 09



Sheet Shoveable 09



Demolition Sheared Scrap



Heavy Sheared Scrap



Pantograph



Cast Iron Ingots



Iron Turning



Rough Turning



Misplaced Truck



Covered Truck



Automatic classification of incoming scrap HMI



Riconoscimento rottame camion



Ricarica Valid recognitions **223/250** Score **0.664**

Timestamp	Materiale classificato	Predizione nr1	Predizione nr2	
30/9/2021, 15:23:45	GHISA IN PANI -01002	GHISA IN PANI -01002	1.00	✓
30/9/2021, 15:21:48	GHISA IN PANI -01002	GHISA IN PANI -01002	1.00	✓
30/9/2021, 15:18:13	LAMIERINO PS 09 -01305	LAMIERINO PS 09 -01305	0.66	LAMIERINO 50 -01300 0.34
30/9/2021, 15:16:42	LAMIERINO PS 09 -01305	LAMIERINO PS 09 -01305	0.94	LAMIERINO 50 -01300 0.03
30/9/2021, 14:58:52	LAMIERINO PALABILE 09 -01308	LAMIERINO 50 -01300	0.90	LAMIERINO PS 09 -01305 0.07
30/9/2021, 14:56:40	LAMIERINO PS 09 -01305	LAMIERINO PS 09 -01305	0.60	LAMIERINO 50 -01300 0.39
30/9/2021, 14:54:43	LAMIERINO PALABILE 09 -01308	LAMIERINO PALABILE 09 -01308	0.77	LAMIERINO PS 09 -01305 0.14
30/9/2021, 14:41:35	LAMIERINO PALABILE 09 -01308	LAMIERINO PALABILE 09 -01308	0.89	LAMIERINO PS 09 -01305 0.11
30/9/2021, 14:39:47	LAMIERINO PALABILE 09 -01308	LAMIERINO PALABILE 09 -01308	0.88	LAMIERINO PS 09 -01305 0.11
30/9/2021, 14:30:29	LAMIERINO PALABILE 09 -01308	LAMIERINO 50 -01300	0.63	LAMIERINO PALABILE 09 -01308 0.35
30/9/2021, 14:28:39	LAMIERINO PS 09 -01305	LAMIERINO PS 09 -01305	0.85	LAMIERINO PALABILE 09 -01308 0.10
30/9/2021, 14:15:19	LAMIERINO PALABILE 09 -01308	LAMIERINO PS 09 -01305	0.81	LAMIERINO PALABILE 09 -01308 0.17
30/9/2021, 14:03:24	LAMIERINO 50 -01300	MISPLACED	1.00	✓
30/9/2021, 14:02:42	LAMIERINO 50 -01300	MISPLACED	1.00	✓
30/9/2021, 14:01:01	LAMIERINO PALABILE 09 -01308	LAMIERINO 50 -01300	0.58	LAMIERINO PS 09 -01305 0.24
30/9/2021, 13:55:29	LAMIERINO PALABILE 09 -01308	LAMIERINO PS 09 -01305	0.62	LAMIERINO 50 -01300 0.22
30/9/2021, 13:48:40	LAMIERINO PS 09 -01305	LAMIERINO PS 09 -01305	0.47	LAMIERINO PS 09 -01305 0.43
30/9/2021, 13:46:55	TORNITURA SGROSSATURA 40 ...	TORNITURA FERRO 41 -01302	1.00	TORNITURA SGROSSATURA 40 ... 0.00
30/9/2021, 13:40:16	LAMIERINO PALABILE 09 -01308	LAMIERINO PALABILE 09 -01308	0.53	LAMIERINO PS 09 -01305 0.28
30/9/2021, 13:35:56	LAMIERINO PS 09 -01305	LAMIERINO PS 09 -01305	0.40	LAMIERINO 50 -01300 0.32
30/9/2021, 13:33:43	LAMIERINO PS 09 -01305	LAMIERINO PS 09 -01305	0.62	LAMIERINO PALABILE 09 -01308 0.36
30/9/2021, 13:27:59	LAMIERINO PALABILE 09 -01308	LAMIERINO PS 09 -01305	0.64	LAMIERINO PALABILE 09 -01308 0.29
30/9/2021, 13:26:30	LAMIERINO PALABILE 09 -01308	LAMIERINO PS 09 -01305	0.70	LAMIERINO PALABILE 09 -01308 0.28
30/9/2021, 13:24:43	LAMIERINO PALABILE 09 -01308	LAMIERINO PALABILE 09 -01308	0.50	LAMIERINO 50 -01300 0.31
30/9/2021, 13:13:11	LAMIERINO PS 09 -01305	LAMIERINO PS 09 -01305	0.79	LAMIERINO 50 -01300 0.20
30/9/2021, 13:11:09	LAMIERINO 50 -01300	LAMIERINO 50 -01300	1.00	✓
30/9/2021, 13:09:29	LAMIERINO PALABILE 09 -01308	LAMIERINO 50 -01300	0.70	LAMIERINO PS 09 -01305 0.27
30/9/2021, 13:07:59	LAMIERINO PALABILE 09 -01308	LAMIERINO PALABILE 09 -01308	0.85	LAMIERINO PS 09 -01305 0.13
30/9/2021, 13:01:59	LAMIERINO 50 -01300	LAMIERINO 50 -01300	0.91	LAMIERINO PS 09 -01305 0.07
30/9/2021, 13:00:26	LAMIERINO 50 -01300	LAMIERINO 50 -01300	0.98	LAMIERINO PS 09 -01305 0.02
30/9/2021, 12:59:04	LAMIERINO 50 -01300	LAMIERINO 50 -01300	0.96	LAMIERINO PS 09 -01305 0.02
30/9/2021, 12:53:31	LAMIERINO 50 -01300	PANTOGRAFO 02 -01304	0.99	LAMIERINO 50 -01300 0.01
30/9/2021, 12:49:29	LAMIERINO 50 -01300	LAMIERINO 50 -01300	0.66	LAMIERINO PS 09 -01305 0.21

Identification of bulky material on Consteel



Identification of bulky material on Consteel HMI

Intercettazione rottame ingombrante

Timestamp	Type	Distance	Cate...
2021-09-28 19:08:44	ALTRO	1	
2021-09-28 19:08:34	ALTRO	1	
2021-09-28 19:08:24	ALTRO	1	
2021-09-28 19:08:14	ALTRO	1	
2021-09-28 19:08:04	VERGELLA	1	
2021-09-28 19:07:54	VERGELLA	1	
2021-09-28 19:07:44	VERGELLA	1	
2021-09-28 19:07:34	VERGELLA	1	
2021-09-28 19:07:24	VERGELLA	1	
2021-09-28 19:07:14	VERGELLA	1	
2021-09-28 19:07:04	VERGELLA	1	
2021-09-28 19:06:54	VERGELLA	1	
2021-09-28 19:06:44	VERGELLA	1	
2021-09-28 19:06:34	VERGELLA	1	
2021-09-28 19:06:24	VERGELLA	1	
2021-09-28 19:06:14	VERGELLA	1	
2021-09-28 19:06:04	VERGELLA	0.98	
2021-09-28 19:05:54	ALTRO	1	
2021-09-28 19:05:44	ALTRO	1	
2021-09-28 19:05:34	ALTRO	1	
2021-09-28 19:05:24	ALTRO	1	

Ricarica

The image grid displays 24 camera snapshots arranged in 4 rows and 6 columns. Each snapshot includes a timestamp in the bottom-left corner and a colored dot (green or red) in the top-left corner. The snapshots show various types of bulky material, including metal coils and scrap, consistent with the 'ALTRO' and 'VERGELLA' categories listed in the table.

Metal Scrap Material and Supplier Analysis



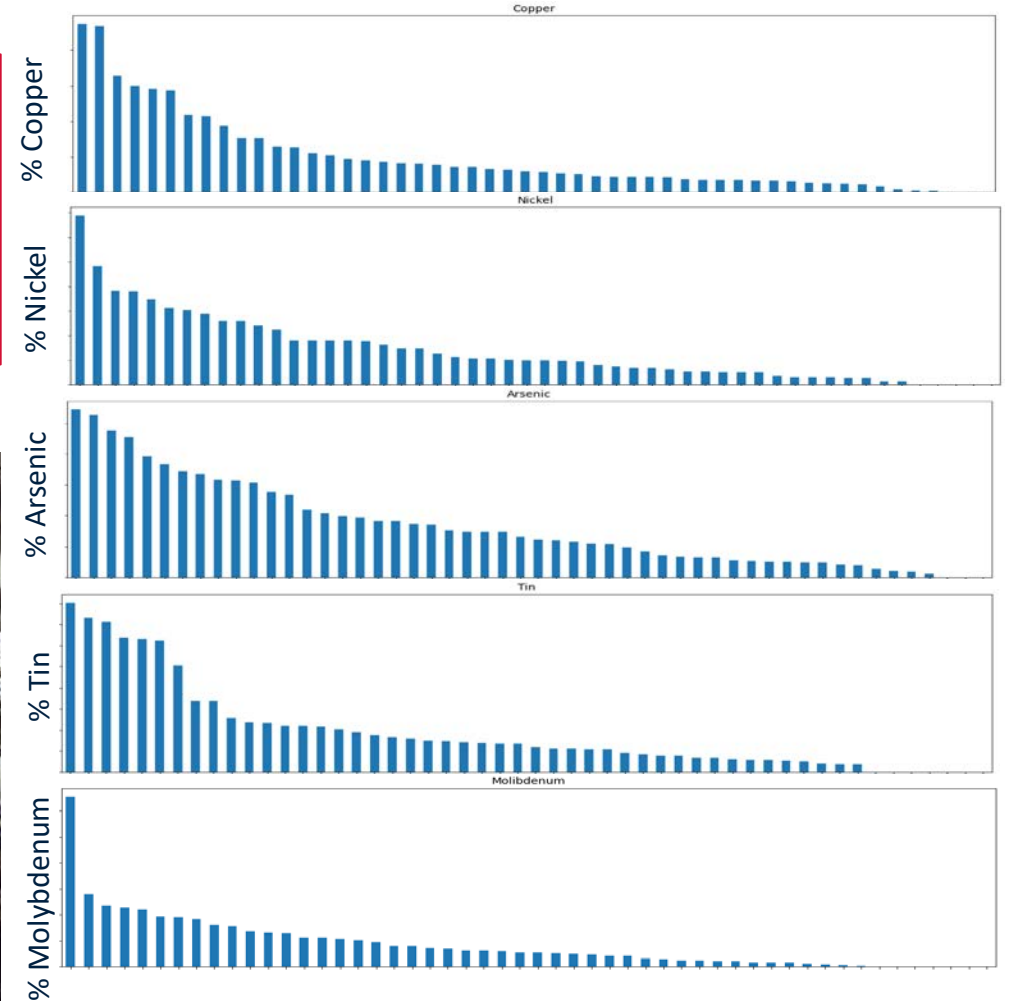
CORRELATION BETWEEN LOADED SCRAP AND LIQUID STEEL IN EAF

Find correlation between loaded scrap material/supplier and chemical analysis of liquid steel for these elements:

Scrap type/supplier

Correlation

Copper (Cu)
Nickel (Ni)
Arsenic (As)
Tin (Sn)
Molybdenum (Mo)



← All combinations of material and supplier →



tenova Analysis prediction

PREDICTION DETAILS

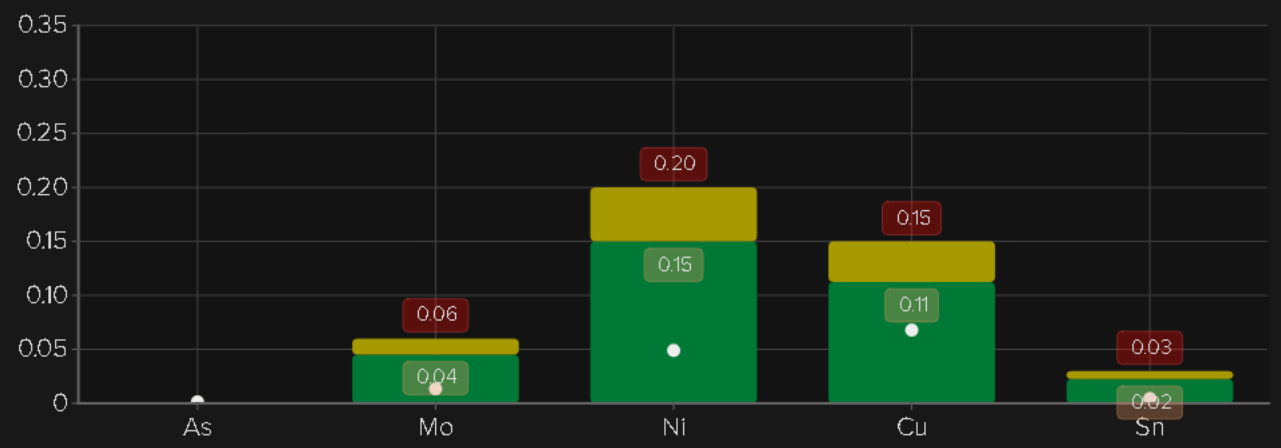
Heat info

Heat	Steel grade	Scrap mix	Load / sched. [t]	Liquid heel [t]
BG2868	TC36A9	B	100.3 / 97.0	27.3

Analysis info

	As	Mo	Ni	Cu	Sn
Max		0.060	0.200	0.150	0.030
Alarm threshold		0.045	0.150	0.112	0.022
Liquid heel	0.002	0.010	0.060	0.080	0.005
Last analysis	0.001	0.012	0.053	0.069	0.004
Estimated	0.001	0.013	0.049	0.068	0.004

Elements prediction



Scrap details

Supplier	Material	Weight [kg]	As [kg]	Mo [kg]	Ni [kg]	Cu [kg]	Sn [kg]
AOM ROTTAMI SPA 007511	LAMIERINO 50 -01300	9935	0.3	3	10.6	15.5	0.8
AOM ROTTAMI SPA 007511	LAMIERINO PALABILE 09 -01308	24693	0.3	3.1	12.9	16.4	1.1
FERSIDER SRL 001654	LAMIERINO PALABILE 09 -01308	1341	0	0.1	0.4	0.8	0.1
AOM ROTTAMI SPA 007511	LAMIERINO PS 09 -01305	58342	0.6	6	20.6	29.1	2.1
FORMISANO FERRO SRL 001668	LAMIERINO PS 09 -01305	738	0	0.1	0.5	0.5	0

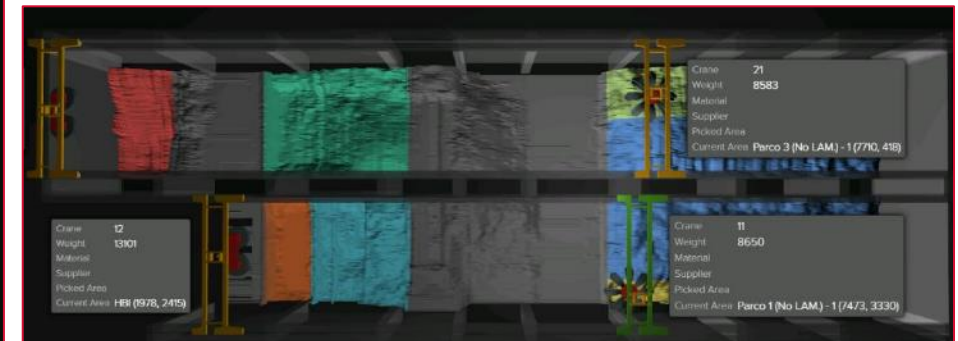
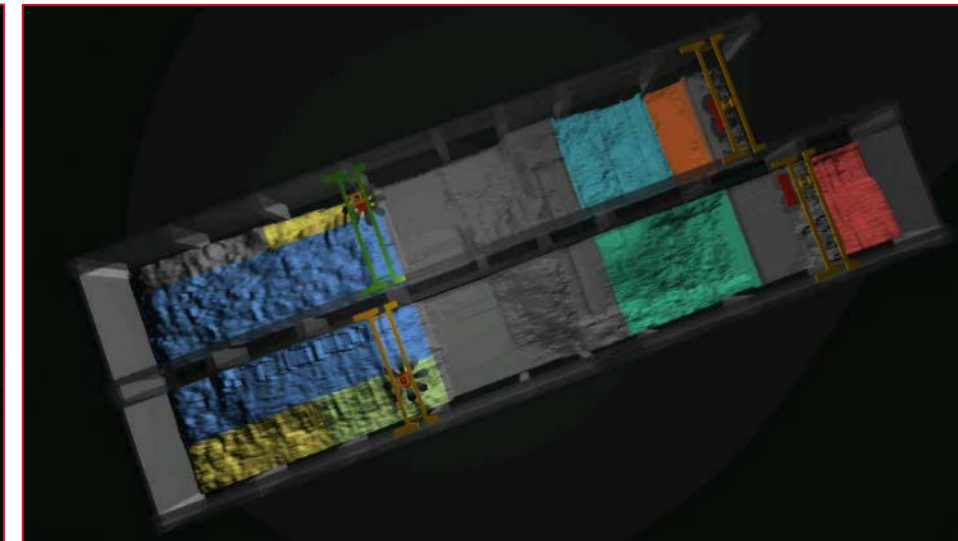
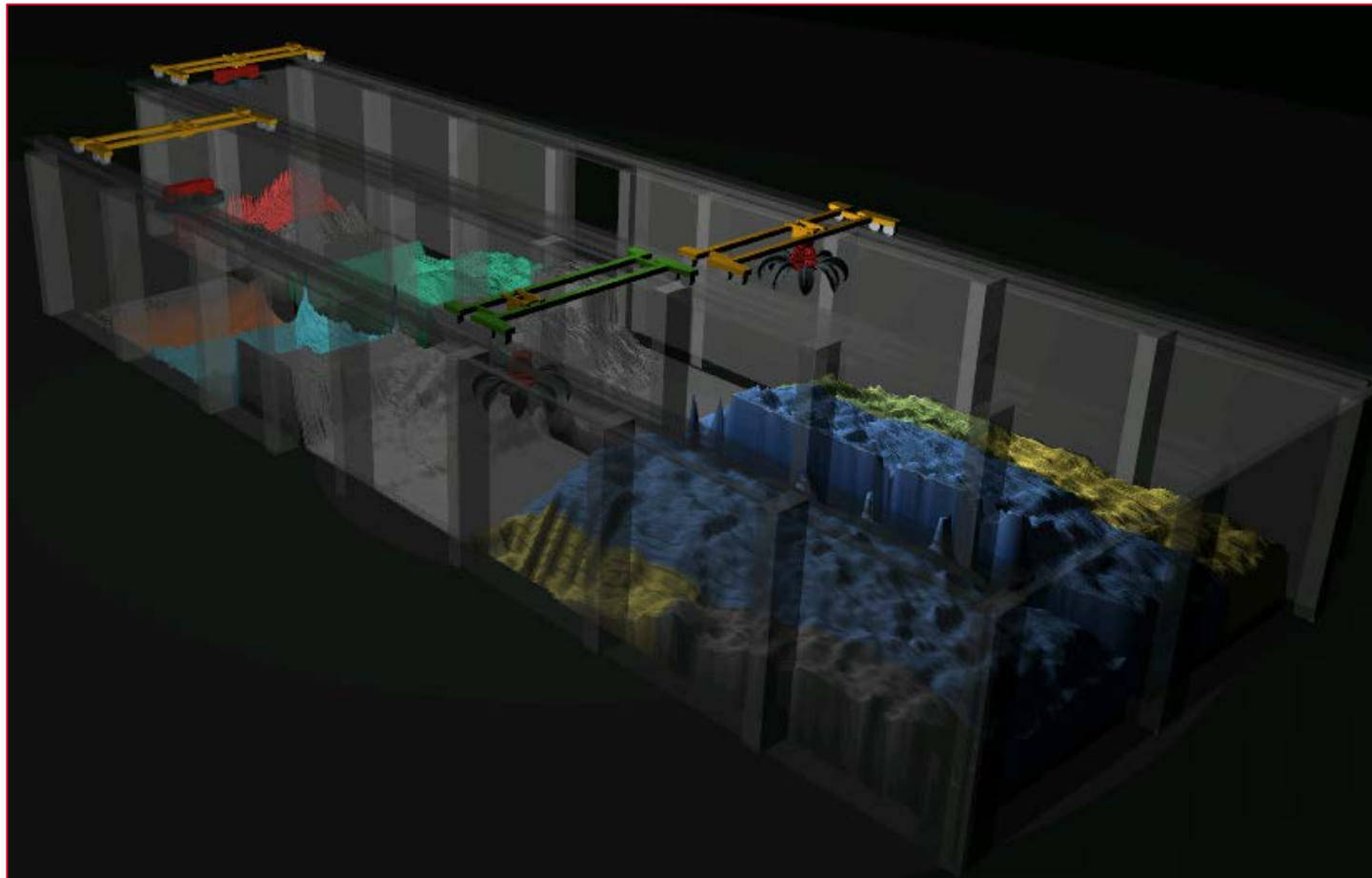
Automatic profiling of the volumes of scrap material



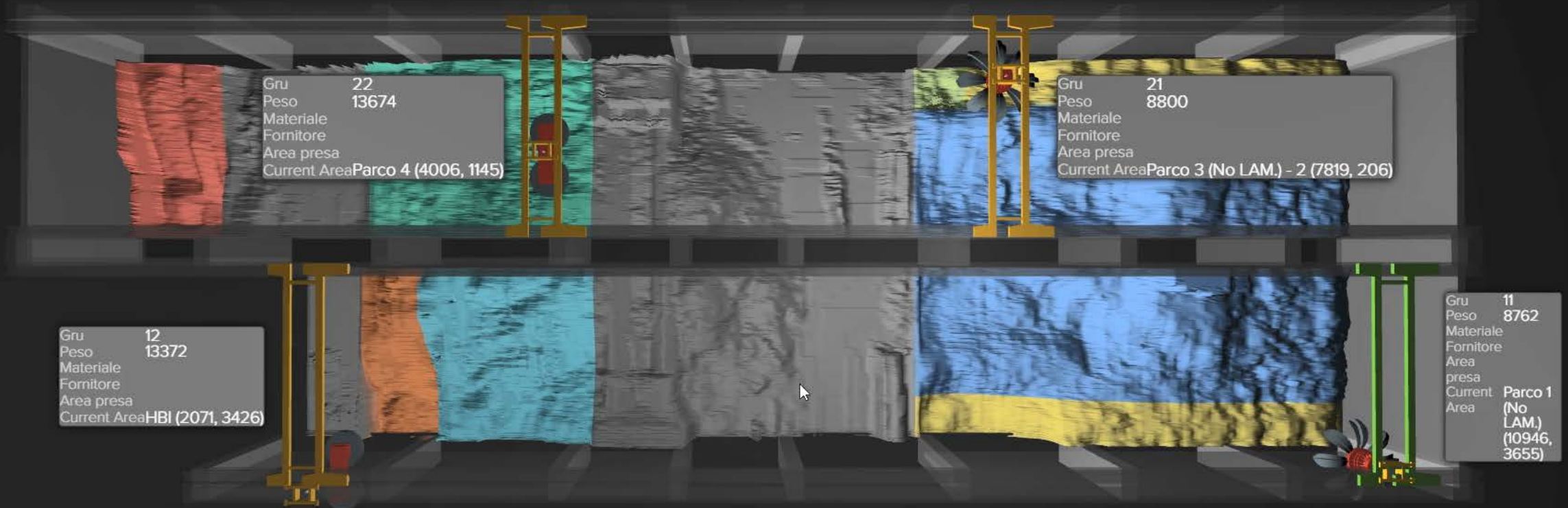
Continuous automatic 3D profiling of volumes in scrap yard by laser scanner mounted on cranes

Volumes mapped in term of position, weight and origin of scrap material

All movements of scrap material are tracked and recorded in terms of time, crane, material, position, weight etc.



Automatic profiling of the volumes of scrap material HMI



Dettagli gru

Top view

Hide walls

Scrap view

Details



Main menu



Dettagli parco rottami



Costruzione letto rottame



Movimentazioni gru



Guest

2/8/2021 18:05:35 PM

System for weighing scrap material on crane

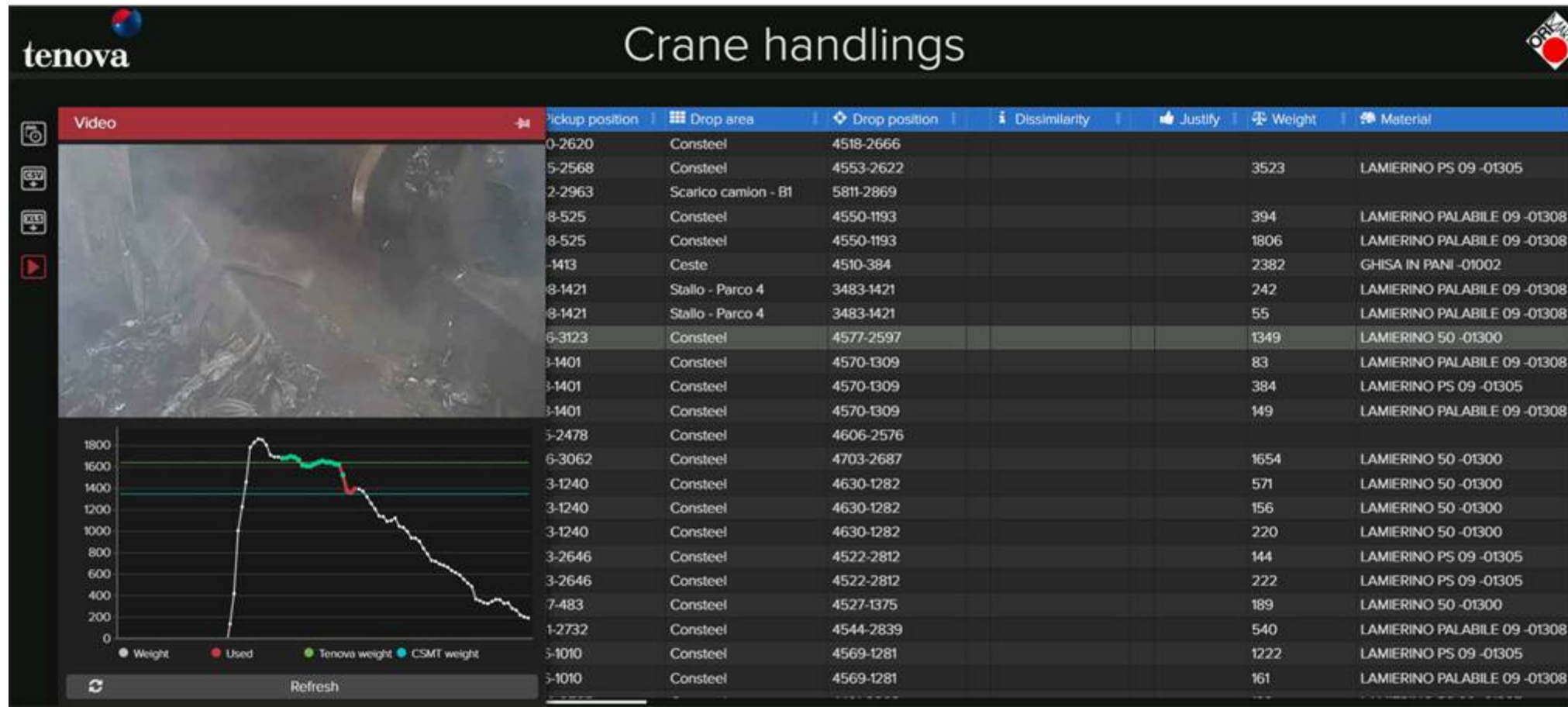
tenova



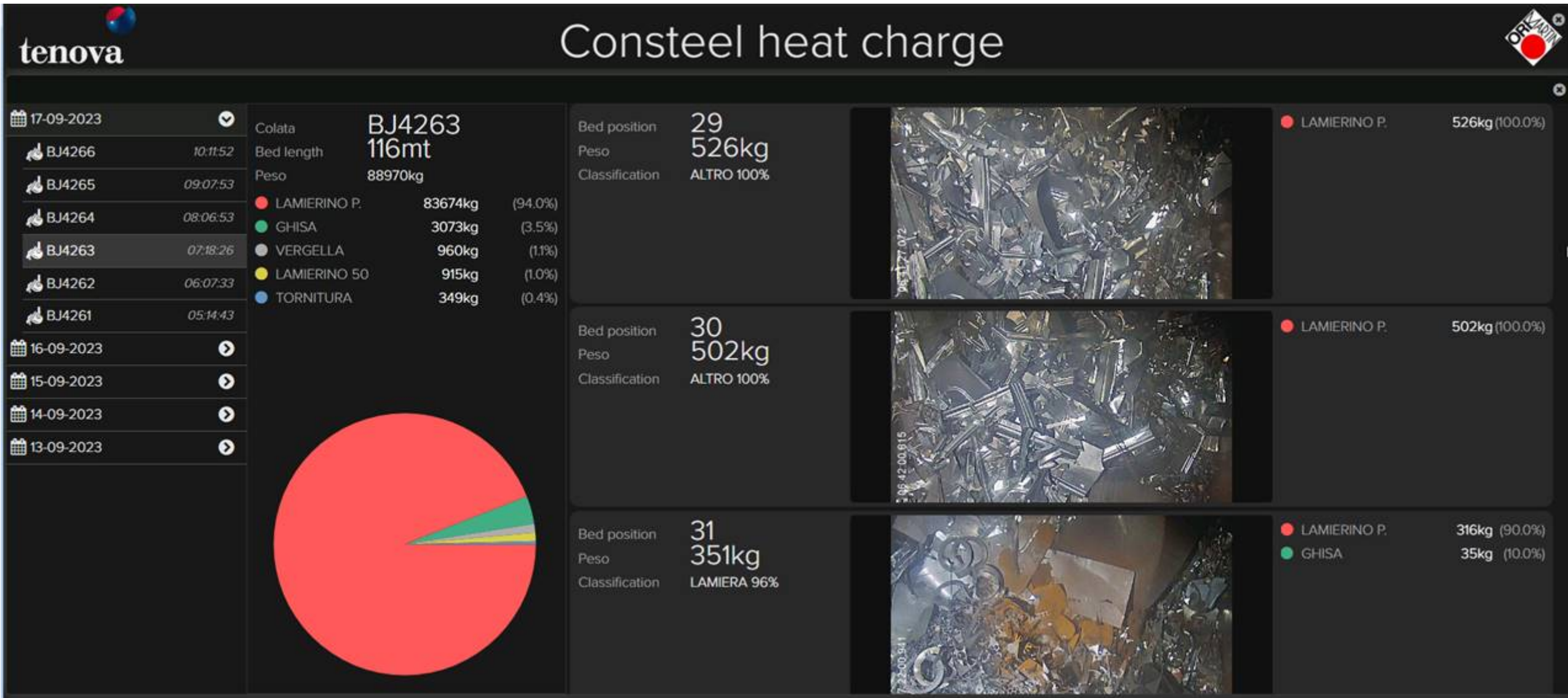
PROBLEM: The measure of the weight of the scrap is **not reliable** while it is transported by using crane.

GOAL: Estimate of the weight of the scrap during transport without having to stop the crane, with an **accuracy of 2%**

SOLUTION: CSMT and Ori Martin have developed an **advanced algorithm** to determine a reliable measure of weight of the grabbed scrap in **real-time**, using a **mathematical model of the crane dynamics**



Automatic scrap classification of scrap material entering EAF



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Thank You!

Giovanni Bavestrelli

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TECHINT GROUP

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