

Electrodynamic Sorting of Light Metals and Alloys

University of Utah

Dr. Raj Rajamani

METALS Annual Meeting

August 24 – 25, 2016

Detroit, MI



Agenda

- ▶ EDX Team Introduction
- ▶ Technical Progress to date
- ▶ TEA Highlights
- ▶ Demo Requirements
- ▶ Future Goals
- ▶ Q&A

EDX Electrodynamic Sorting Project Team



EDX

Electrodynamic Sorting

Dr. Raj Rajamani - Principal Investigator

Dr. James Nagel - Senior Engineer

Dave Cohrs - Research Associate

Jaclyn Ray - Graduate Research Assistant

Dawn Sweeney - Graduate Research Assistant

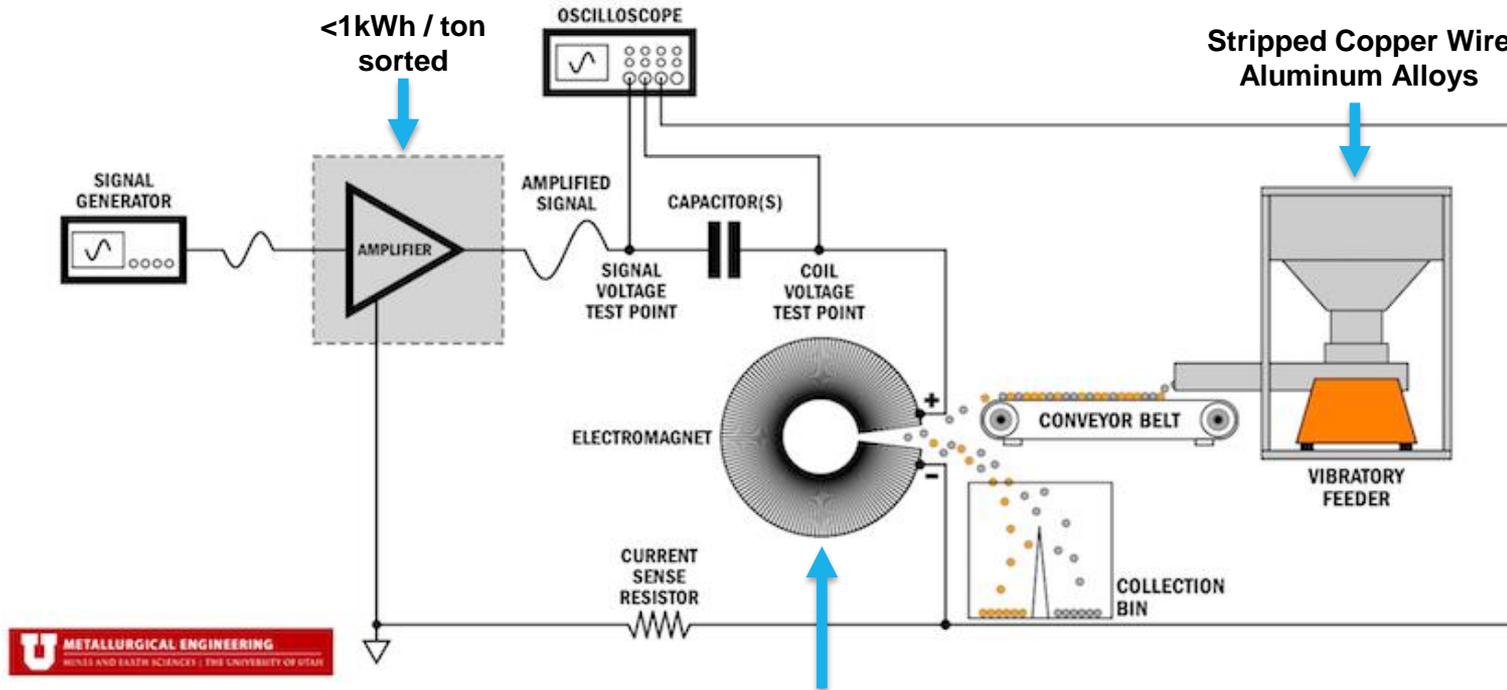
Jake Salgado - Undergraduate Research Assistant

We separate nonferrous metals and alloys from mixed recycled scrap

We save energy by recycling rather than mining

We create value by recovering materials which cannot be sorted using current technologies

EDX Technical Concept



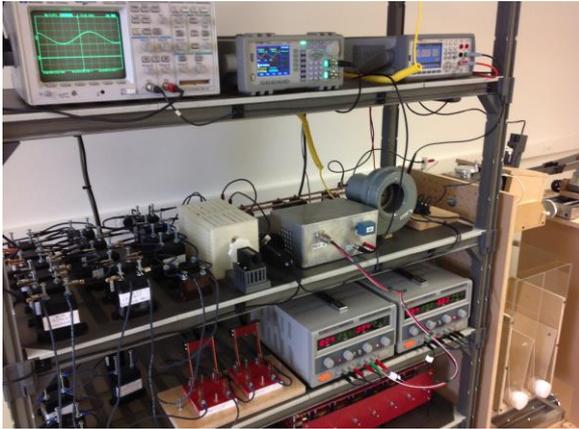
Current ECS technology



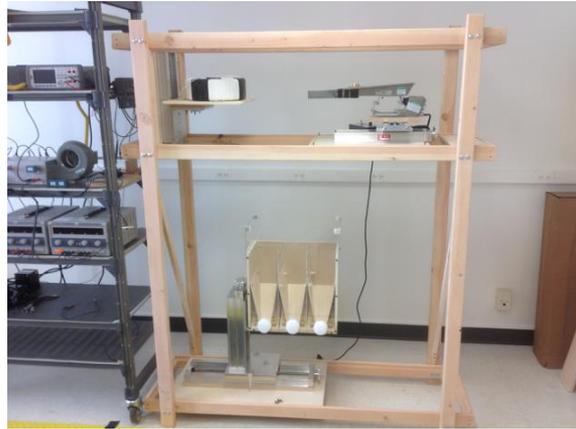
Spinning magnets in traditional eddy current sorters can only generate approximately 100-500Hz hence, limited to larger particle sizes (2" and above)

- Variable frequency (1 – 50kHz and beyond)
- Solid state / no moving parts
- Can sort particle sizes below the current practical cutoff of commercially available machines (1-25mm typical)

Technical Progress to Date



First laboratory test bed



EDX lab set up (Nov 2014)



EDX pilot setup (Jul 2014)



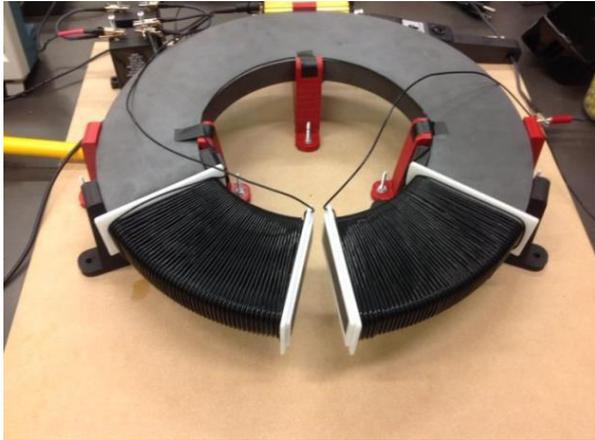
Feeding copper and aluminum scrap to EDX prototype



Electronic scrap sorting demonstration

First year efforts

Technical Progress to Date



440mm test magnet



Zorba sorting lab prototype



Zebra sorting lab prototype

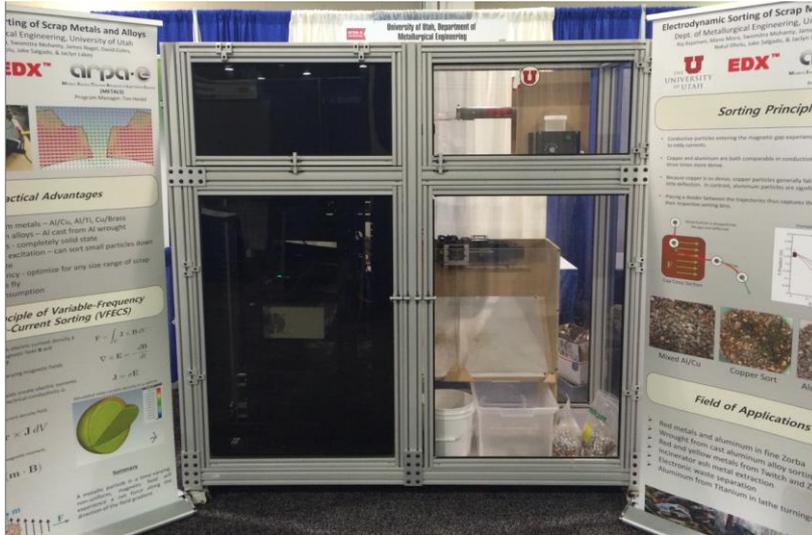


Zorba sorting test

**Second
year
efforts**

Technical Progress to Date

Third year efforts



ARPA-e Energy Summit Expo booth demo of EDX sorting Zorba (Feb 2016)



Sorted Zebra [copper (L) and reject (R)] and Zebra EDX field test prototype (May 2016)



Technical Progress to Date

- ▶ **What would you consider your biggest successes to date?**
 - We have deployed a EDX Zebra sorter at Western Metals Recycling for five days.
 - demonstrated sorting of 1-4mm copper and aluminum from brass, zinc, lead, and steel
 - EM-1 system performed near flawlessly
 - Rugged against dusty conditions
 - Uninterrupted processing over 4-hour blocks
 - (96% grade, 90% recovery)
 - opportunities with alternative streams in the Zebra family

- ▶ **Where do you still have additional work to complete?**
 - In Jan-Mar 2017, we will install a Zorba sorter at Southern Core Recycling, Houston, TX
 - Will process 200-500 kg/hr under 1 inch Zorba
 - This success translates to alloy sorting



May 2016

Technical Progress to Date

Sorting Results: Zebra 1-4mm

Throughput = 20 kg / hour

Recovery = 90 %, Grade = 97 %



Mixed Zebra feed stock



Reject Bin



Sort Bin

UPDATE: This has since been improved!

Technical Progress to Date

Sorting Results: Fine Zorba 8-11mm

Throughput = 50 kg / hour

Recovery (Al) = 92 %, Recovery (Cu) = 87 %, Grade (Al) = 92 %, Grade (Cu) = 87%



Mixed Al/Cu (65/35)



Reject Bin



Sort Bin

Technical Progress to Date

Sorting Results: Cu and Al cylinders (lab)

Throughput = 233 kg / hour

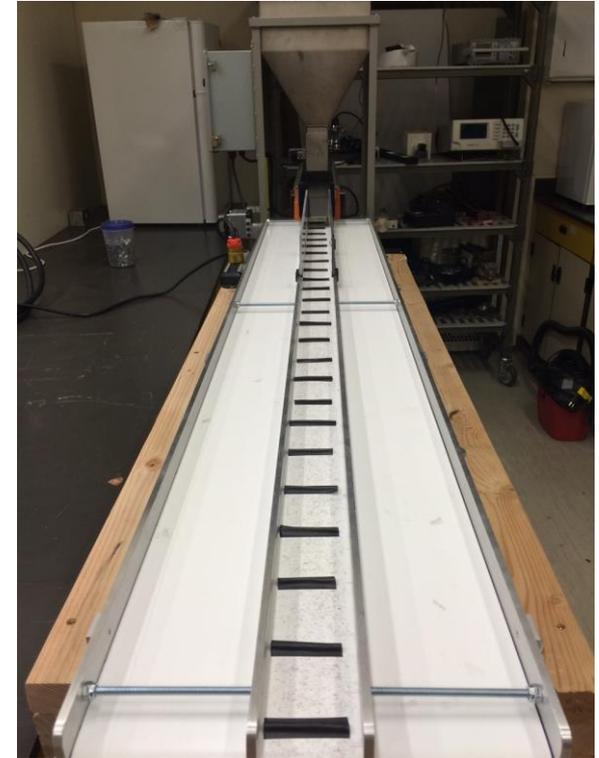
Recovery (Al) = 99.4 %, Recovery (Cu) = 98.5
Grade (Al) = 97.8 %, Grade (Cu) = 99.5%



**Mixed Al/Cu
12mm cylinders**



Sorting results



Belt fed prototype

TEA Highlights

What price range are you targeting for this product? How does this compare to current market?

- *We estimate approx. \$60-100k for a 20-80kg/hr Zebra system*
- *We also estimate approx. \$100-180k for a 100-250kg/hr Zorba system*
- *Comparable throughput conventional eddy current sorters (for Zorba type products) can cost upwards of \$200-250k*



Industrial shredder (ISRI 2015)

TEA Highlights

What are other benefits of your process over a comparable process?

- EDX seeks to capture currently unrealized value in recycled metals products
- EDX sorted products stay domestic, minimizing further carbon input and import buyback premiums
- EDX can sort particles 1-25mm with high grade and recovery
- Only comparable tech is Xray combined with optical methods. Xray machines are upwards of \$1-2M whereas EDX would be ~10% of that.

The U.S. Aluminum Industry

YEAR	ALUMINUM RECOVERED FROM SCRAP (MT)	TOTAL ALUMINUM USAGE (MT)	ALUMINUM SCRAP EXPORTS*(MT)
2010	2,700,000	5,053,000	1,913,000
2011	3,110,000	5,099,000	2,125,000
2012	3,430,000	5,768,000	2,034,000
2013	3,480,000	6,196,000	1,869,000
2014	3,640,000	6,240,000	1,718,000

* Includes UBC's and Remelt Secondary Ingot.

Source: ISRI 2015

The ultimate goal for this project is...

- To develop and bring to market a 1ton/hr Zorba/Alloy sorter which will sort mixtures of 380 Castalloy, 5000, 6000, and 7000 series aluminum alloys

In 5 or 10 years, we expect to...

- By the end of 2017, we will engage engineering companies to transition from prototype/laboratory scale to plant scale embodiments of the EDX technology
- We expect to expand into a commercial entity with several embodiments of EDX technology to meet market/recycled product demand
- In five years we would like to achieve market share

Future Goals

What we would like you to know...

- **Our technology has the potential to revolutionize the recycling industry by saving energy, preserving raw materials, offsetting carbon emission, helping to create industry jobs, and to create value from previously unsortable products**
- **By mid 2017, we expect to have a belt feeder EDX capable of 500-1000 kg/ hr capacity which can sort Zorba and alloy mixtures**
- **We are looking for partners who are already manufacturers of recycling and sorting process technology**
- **We are seeking \$1M in additional funds by mid 2017**

QUESTIONS?