

# **AUTOMATED WIRING WITH LIBRODUCT**

Recontacting to the overhead wires *everywhere*

**Erik Lenz (Freelance), Dr. Jan Messerschmidt**

**LibroDuct GmbH & Co. KG**

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# IMAGE IMPROVEMENT OF TROLLEY BUSES

In 2014 at trolley:motion event in Hamburg: we need to improve the **IMAGE** of the trolleybus!

It was about time for a new branding: **In Motion Charging**

**So today we can celebrate 10 years of IMC!**

YouTube video: "The Trouble with Trolleybuses"

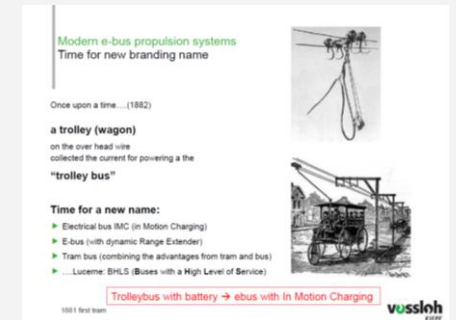


With IMC - "lots of benefits", but the problem is: **re-wiring is still an issue**

It is about time of the **next technologic** and image improvement with a new

**Current Collector** with which can **re-connect everywhere!**

And in 10 years from now, it will be the new standard!



Original IMC slide 2014



UITP Knowledge Briefs IMC

RMTransit YouTube video: "The Trouble with Trolleybuses"

<https://www.youtube.com/watch?v=EgP2fgYFPuY&t=31s>

# RECONNECTION WITH FUNNELS

Reconnection with funnels works,

- 1) if there are (enough) funnels and
- 2) if the bus parks straight under it !

- ... if not, it does **NOT** work!

- e.g. when wires (& funnels) are not / can not be above the parking position

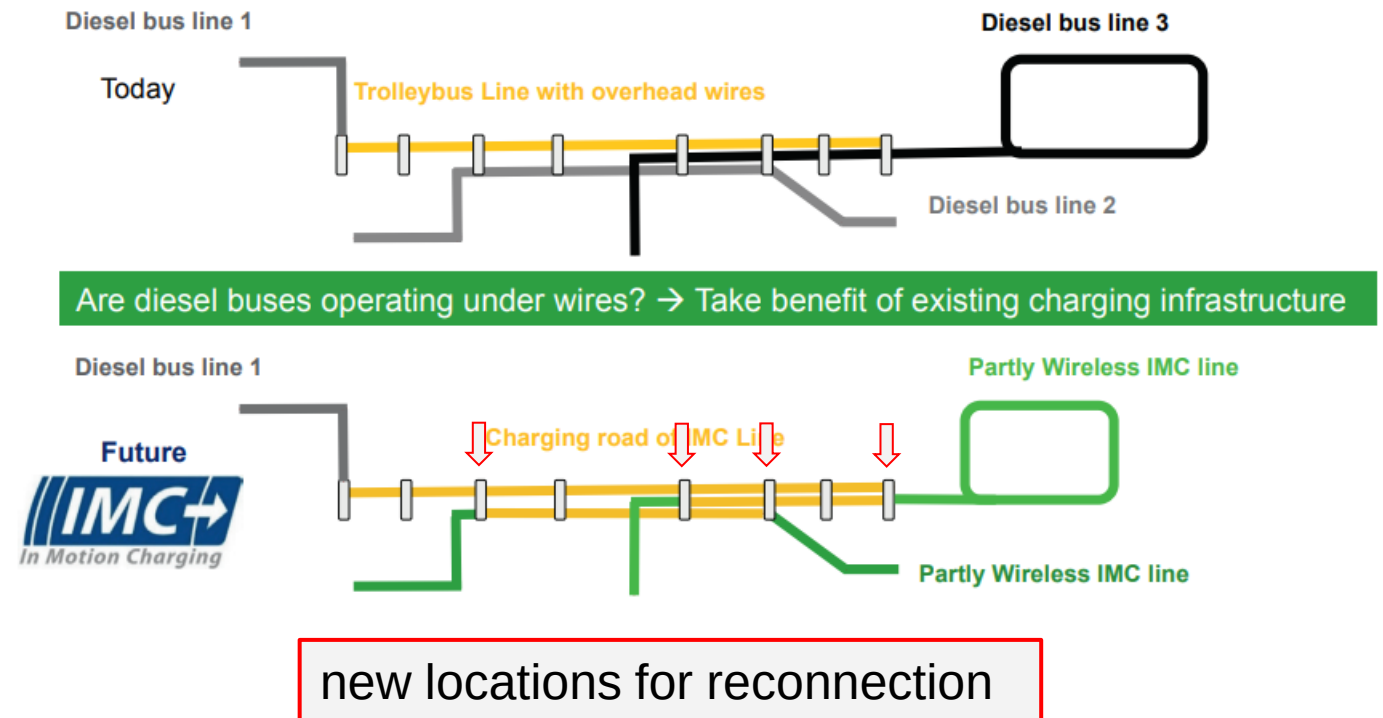


# RECALL: “THE FUTURE OF IMC”

- The future – 5 years ago:
- Is present today
- With different bus lengths:  
12m, 18m, 24m  
Bratislava (& soon Biel) has all 3 lengths.
- Requiring reconnections

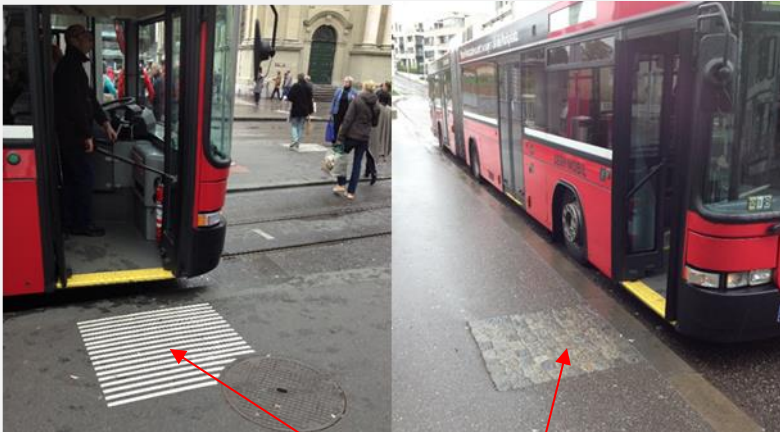
## The future of Electro-Mobility with IMC

Transforming Diesel bus lines into partly wireless IMC lines

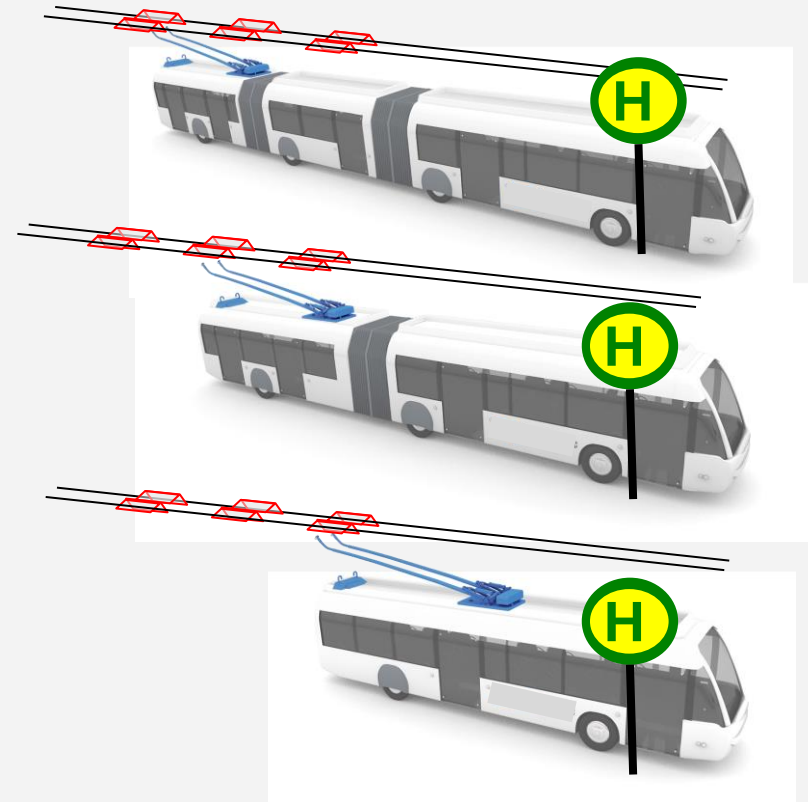


# 1) IF THERE ARE (ENOUGH) FUNNELS

- Different funnel positions are required depending on bus length



Bern: Bus stops with tactile paving marking entrance for **blind people**.

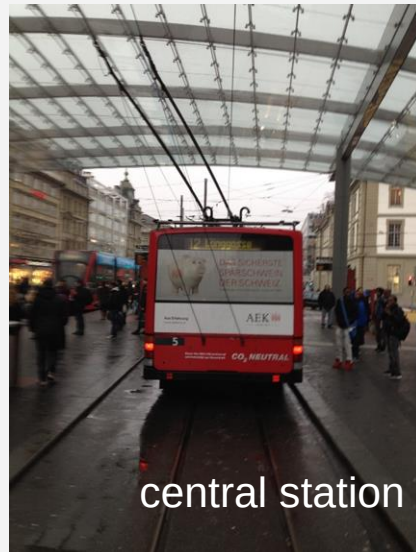




## 2) IF THE BUS PARKS STRAIGHT UNDER WIRES / FUNNEL

Very common situation: **Wires** are not above the parking position at bus stops / bus bays

Bern



Lyon



Tallinn



**Automatic re-connection with funnels is not possible**  
if overhead line is offset to the bus!

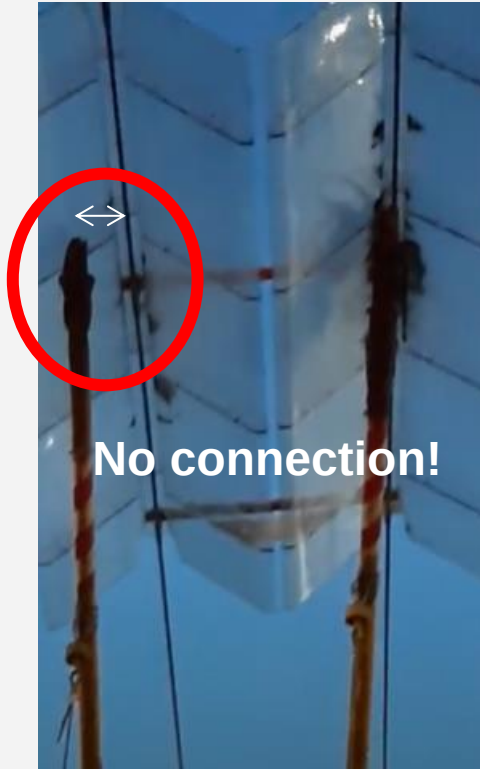
## 2) IF THE BUS PARKS **REALLY** STRAIGHT UNDER WIRES / FUNNEL



Bus was parked

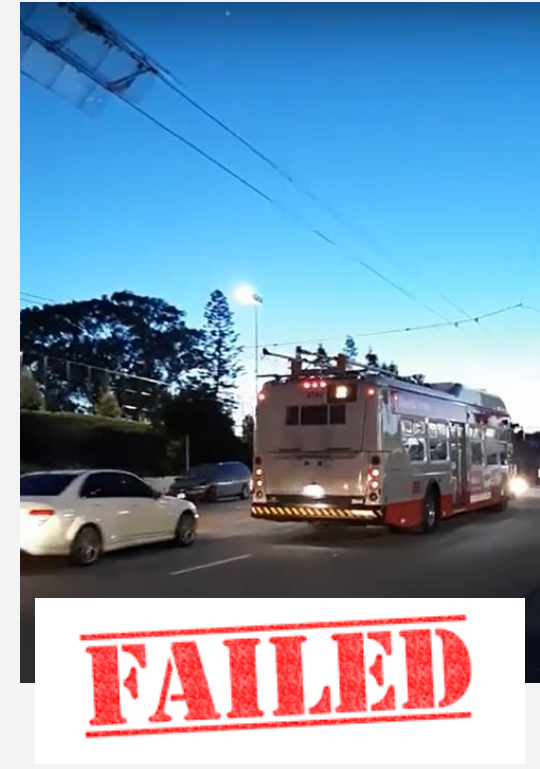


Heads hit the funnels



No connection!

One head got stuck!



Bus continues disconnected  
in battery dis-charge mode  
after 3 minutes road blocking.

# SITUATION TODAY

**Humans might re-connect manually** (if no funnel is accessible nearby)

- after bypassing a **traffic accident**, **demonstration** or **construction site**
- an **uncorrected parked bus** (< 1%)
- **Head got stuck** in the funnel
- E.g. **car blocks** the parking spot under funnel
- Certainly after a **derailment** with an entanglement of the heads



Welcome in the most modern Trolleybus



- Dangerous for the bus driver
- Makes bus driver job less attractive
- Annoying for waiting passengers
- Creating traffic jams
- Ineffective / time consuming
- **Image: NOT MODERN!**



# SITUATION TODAY



Driverless Robo Taxis



This is modern

Bus drivers re-connecting trolley rods



This is **NOT** modern

**WANTED:** Driverless / Automatic **Connect-Everywhere-Current-Collector CECC**

**BREAKING NEWS: CECC is available now**

# LIBRODUCT – THE COMPANY

- Founded 2018
- As spin-off of DiaLOGIKa GmbH (software house, 150 staff members)
- Start-Up Technology Company
- Focus on electromobility / trolleybus.



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- As spin-off of DiaLOGIKa GmbH  
(software house, 150 staff members)
- Start-Up Technology Company
- Focus on electromobility / trolleybus
- IT / Software for „mechatronics“
- Holds several patents
- Member of
  - Trolley:motion
  - Forum für Verkehr und Logistik
  - ASAM (the “European SAE”, member #400 ☺).



Dr., Dipl.-Inform.



M. A.



M. Sc.



Dr., Dipl.-Inform.



Dipl.-Phys.



M. Sc.



M. Sc.



M. Eng.



stud. inform.



# WHAT IS THE LIBRODUCT CECC APPROACH?





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# WHAT IS THE LIBRODUCT CECC APPROACH?

- Fully automatic re-contacting of the trolley rods to the overhead wires
- During stand still (current state) and while in motion (our vision)

Funded by:



Federal Ministry  
for Digital  
and Transport

Coordinated by:



In cooperation with Bergische  
Universität Wuppertal



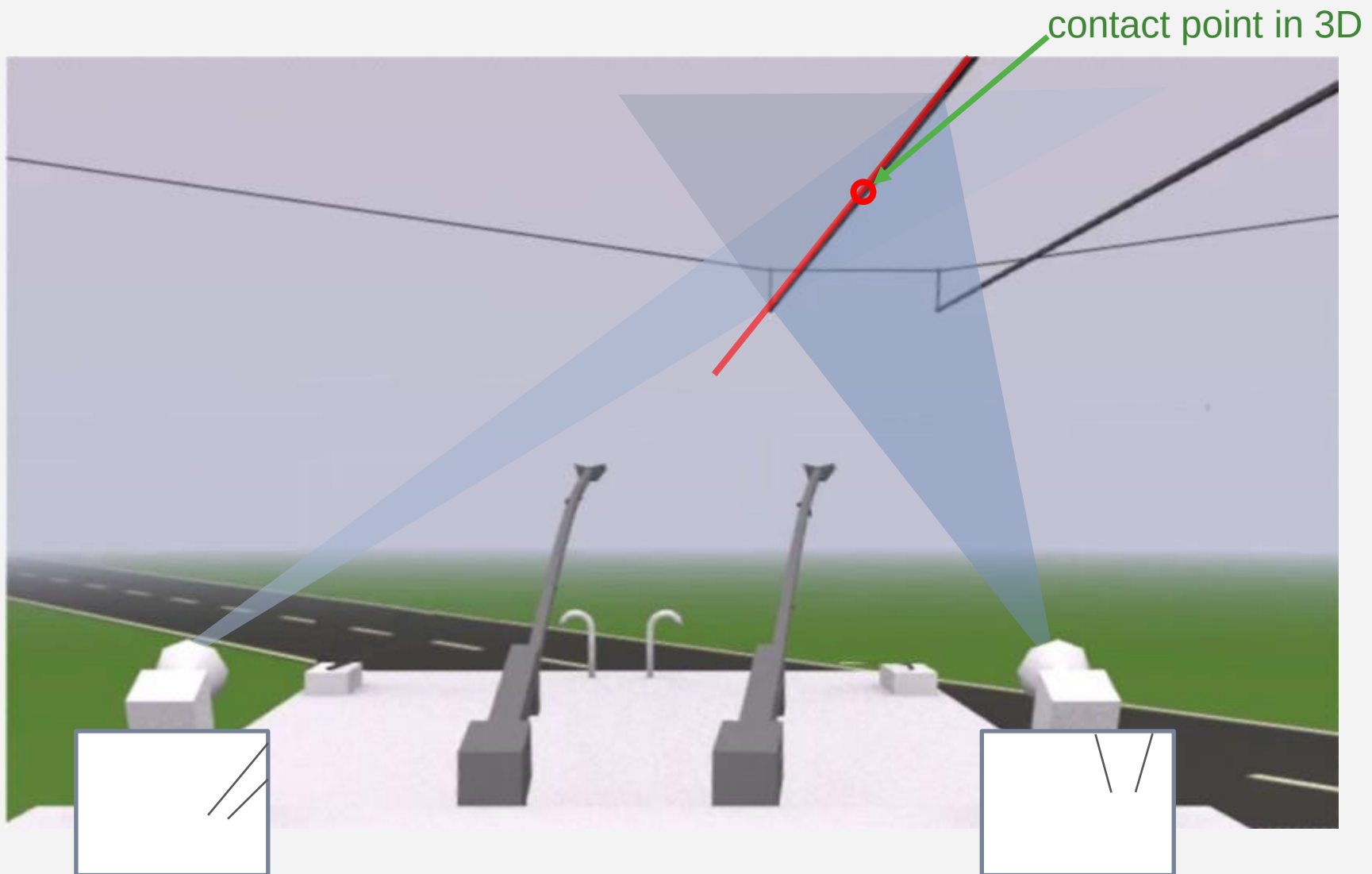
# WHAT IS THE LIBRODUCT CECC APPROACH?

- Fully automatic recontacting of the trolley rods to the overhead wires
- During stand still (current state) and while in motion (our vision)
- Recontacting everywhere
  - even when the bus is not in line with the overhead wires
  - without funnels or any special infrastructure
- Our vision:  
Driving like Diesel buses
  - no driver interaction.



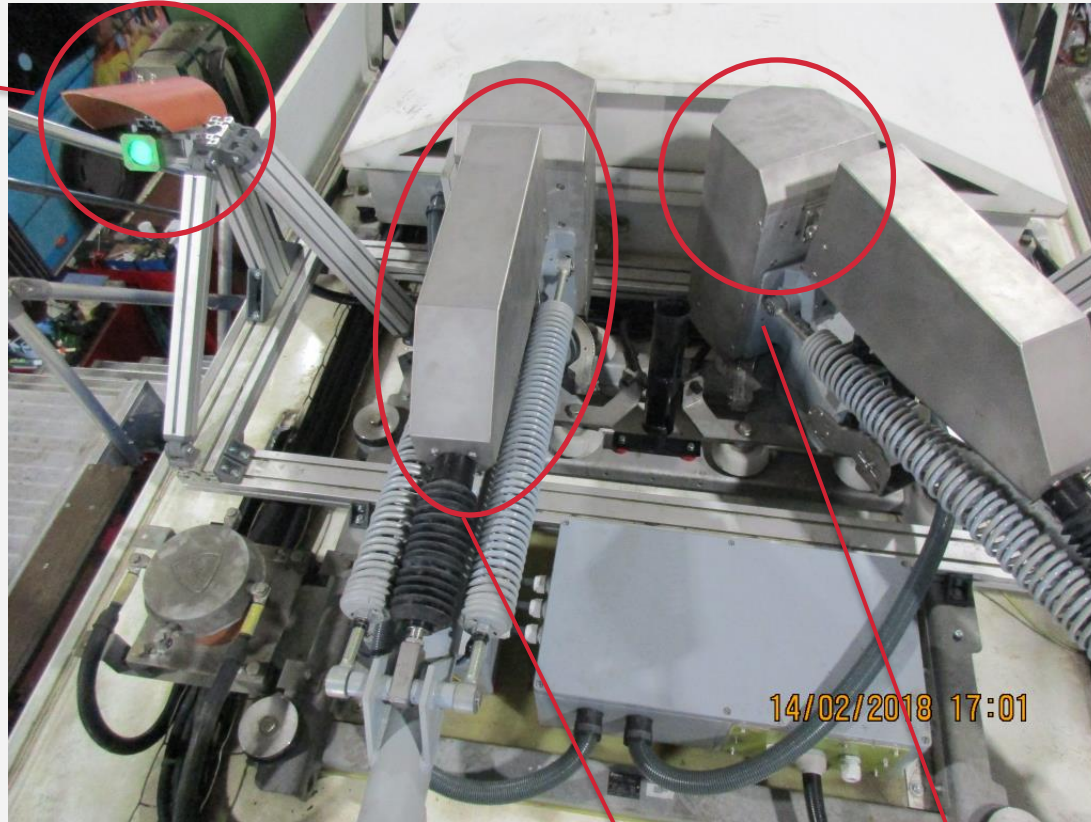
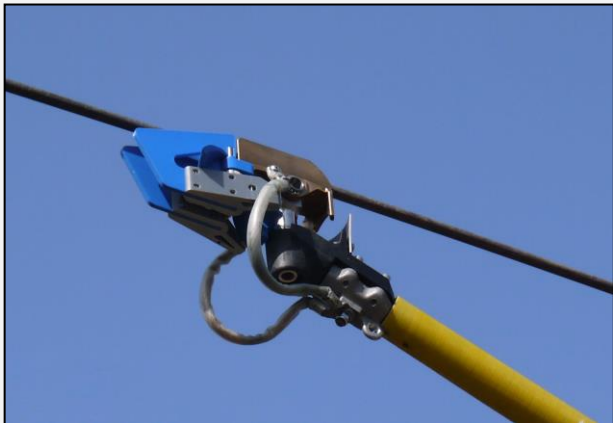
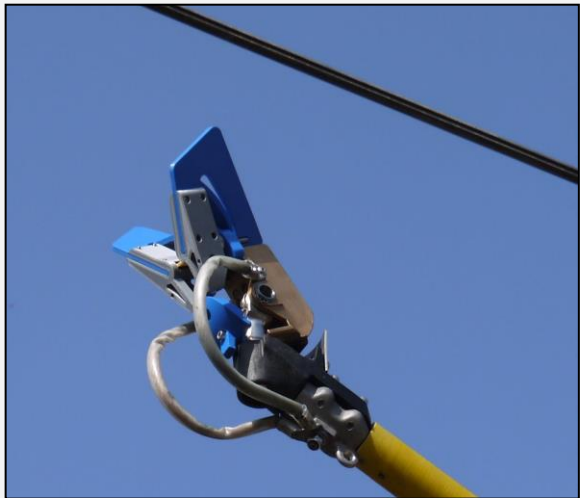


# STEREO OPTICAL PATTERN RECOGNITION PRINCIPLE



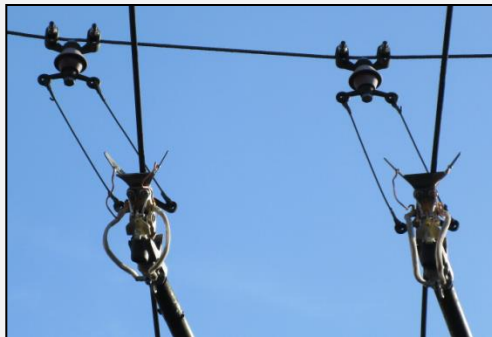
# WINGED HEADS AND OTHER COMPONENTS

Camera

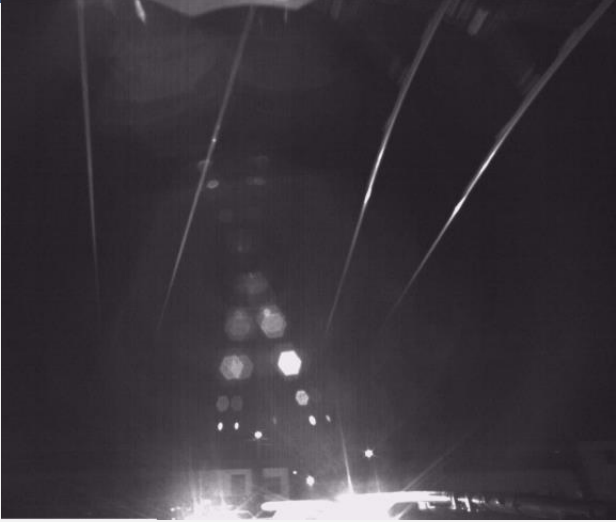


Horizontal Actuator

Vertical Actuator



# OPTICAL RECOGNITION



At Night.

Camera

Light



# AUTOMATIC RECONTACTING “LIVE”

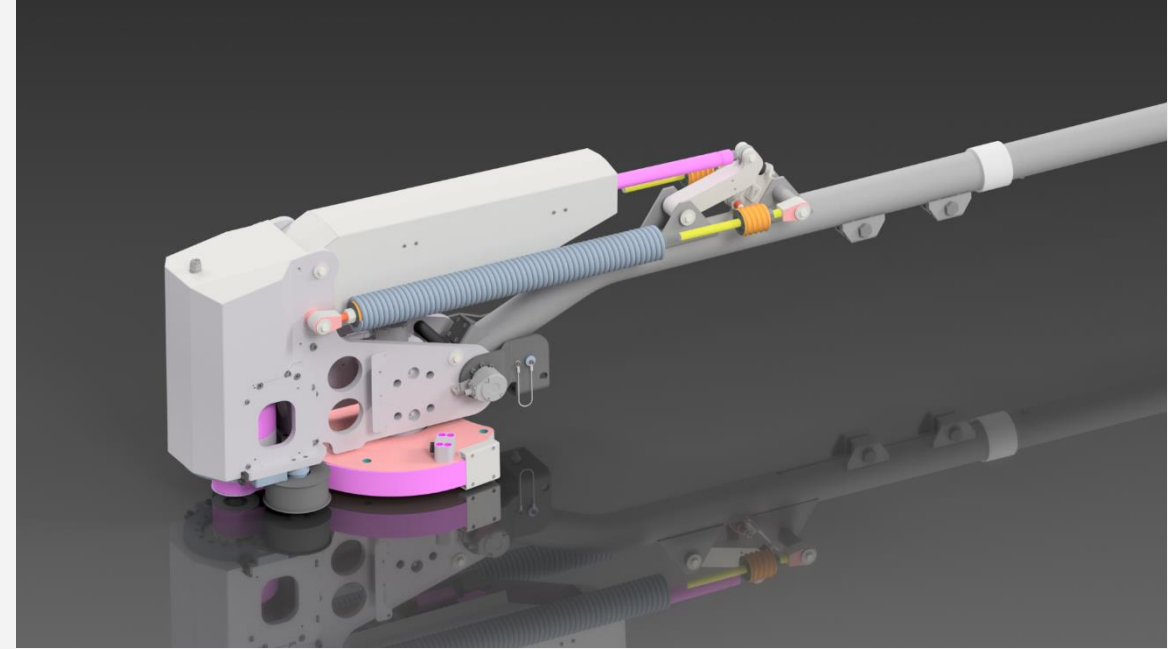
Connecting to the overhead wires is  
done with pushbutton ease



# CECC – CONNECTING EVERYWHERE CURRENT COLLECTOR

## CECC Timeline

- CECC is available starting in Q3 2025
- Maturity based on >10 years development with 4 product generations
- Ready for sale NOW.



# NEW CATENARY MEASUREMENT TOOL

## The Case:

- Partial “derailment” / de-wiring
- Damage pattern new vs. after 6 months
- E.g. with suboptimal curve design
- Metal parts of the contact shoe grind against the wire of the overhead line
- Danger of the overhead wire falling.



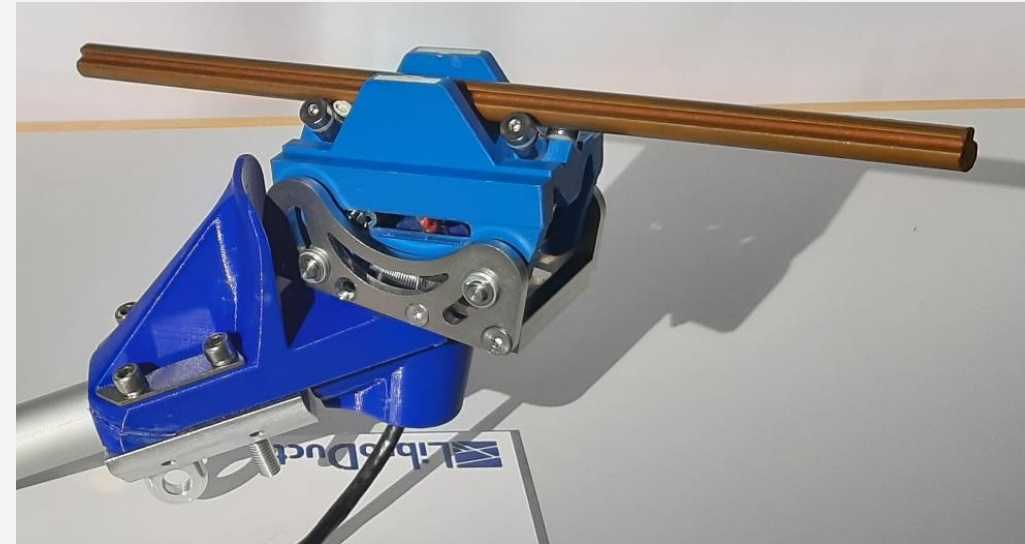
Source: tl Lausanne; Foto: M. Mohler / K+M

**LINIENABZWEIGUNG**

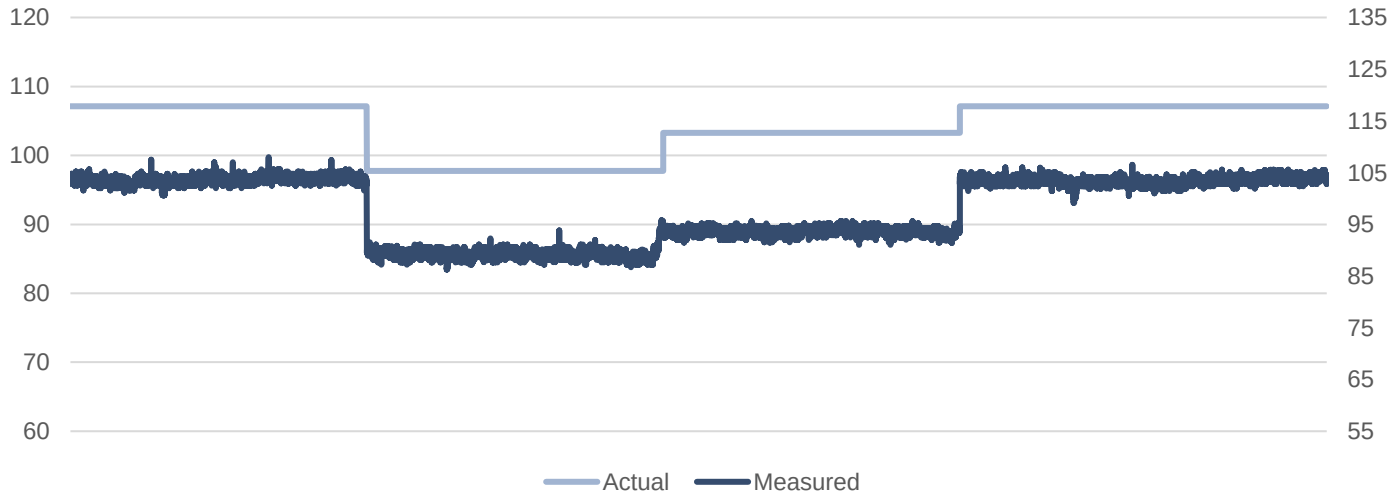
# NEW WIRE MEASUREMENT TOOL: LIBRODUCT W<sup>2</sup>M

## The Solution:

- Periodical measurements are run in your network
- Carried out by yourself with LibroDuct W<sup>2</sup>M:  
Wire Width Measurement
- High precision measurement “contact” head



Comparison of actual and measured thickness



- Measures the (horizontal) thickness of the overhead line wires
- Correlation of the measured values to the simultaneously recorded GPS location

# CECC: SHORT LIST OF ADVANTAGES



## ■ Operation reliability & flexibility

- Reliable automatic re-connection / reliable recharging
- Allows easy trying out new lines or routes
- Bypassing accidents, demonstrations or construction sites



## ■ Cost saving

- No funnels / no funnel approvals / no funnel maintenance
- Avoids personal costs for manual reconnection
- Removes maintenance intensive equipment like switches



## ■ Bus driver safety

- Safe: keeps the bus drivers away from the dangerous street
- Avoiding traffic jams: no irritations and aggressive behavior
- Stressless: no worries about derailments or range anxiety

## ■ High Tech Image

- Automatic re-connection (from bus bays)
- No “optical pollution” by funnels (or switches)
- Quiet re-connection (no noise from funnels)



## ■ Highest Energy Efficiency

- Sooner back on wires to the most efficient power supply
- Sooner avoiding the 15% losses from battery charge/discharge
- Optimized energy consumption, CO<sub>2</sub> footprint & sustainability



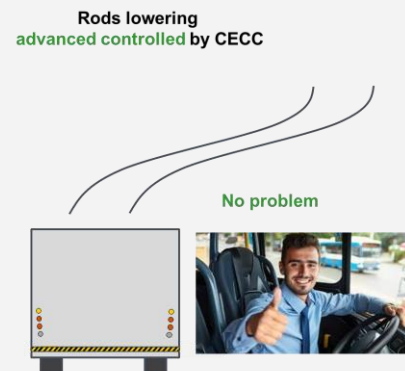
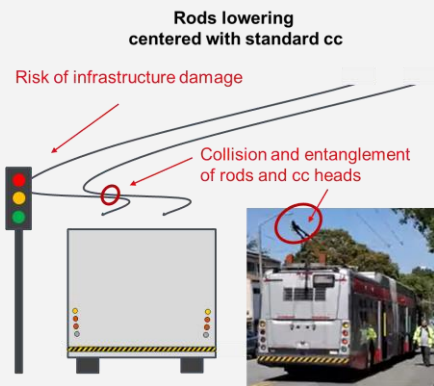


# CECC: FURTHER ADVANTAGES

- Enables **overtaking**, e.g. at bus terminals, express lines

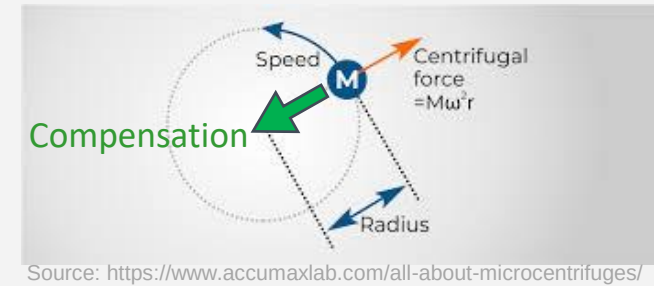


- Prevention** of infrastructure or rod **damage** or **entanglement** during fast lowering of rods



- Rods **lowering** while driving

- Centrifugal Force Compensation** (CFC) in curves leads to reducing derailment & allowing higher speed



- Carbon saving** by decreased contact force



- Automatic **rods lowering** for carbon maintenance

# ROD CONTROL FOR RAPID LOWERING

With traditional cc:  
**1 point control**

Movement of rods & head?

With CECC:  
**multi point control**



**Risk of infrastructure damage**

**Collision and entanglement**

**Dewirement & Rapid Lowering!**

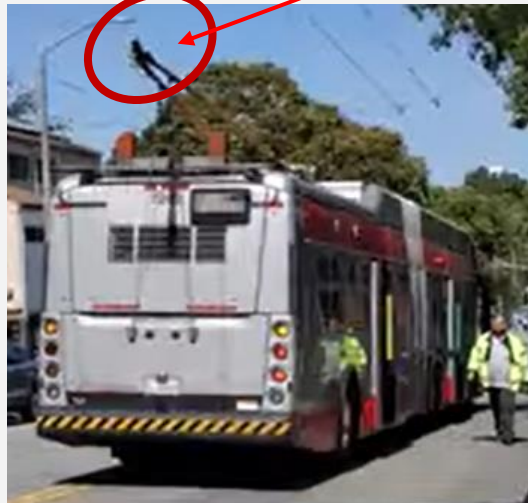
Force of 1 point control  
might create oscillations

Starts vertical  
gently to the wires

Gently to  
heads & rods

multiple points  
controlled forces

**No worries**



# WANT TO GET ALL THESE ADVANTAGES?

- **Request** in your upcoming invitation to tender an innovative current collector (iCC) “reconnect without funnels”

- **How?** Example from the past:

|                                            |              |              |
|--------------------------------------------|--------------|--------------|
| 50 points                                  | if iCC costs | 50.000 CH/€  |
| 0 points                                   | if iCC costs | 100.000 CH/€ |
| else: x points linear between these prices |              |              |

- **Want to test it first? No problem:**

– Fast & easy on trailer                      or                      integrated on your bus



- **(Pre-) order your first CECC now**



# THANK YOU FOR YOUR ATTENTION

Connect Everywhere Current Collector CECC



## LibroDuct GmbH & Co. KG

Pascalschacht 1  
66125 Saarbrücken  
Germany

Phone: +49 (6897) 935-0  
Fax: +49 (6897) 935-100  
Web: [www.libroduct.com](http://www.libroduct.com)  
E-Mail: [ebus@libroduct.com](mailto:ebus@libroduct.com)

**Erik Lenz**  
Freelance  
+49 174 1645 963  
LinkedIn: [erik-lenz-emobility](#)  
[erik.lenz.extern@libroduct.com](mailto:erik.lenz.extern@libroduct.com)