Collaborative feature location in models through automatic query expansion

Human-Competitive Awards 2019

GECCO 2019

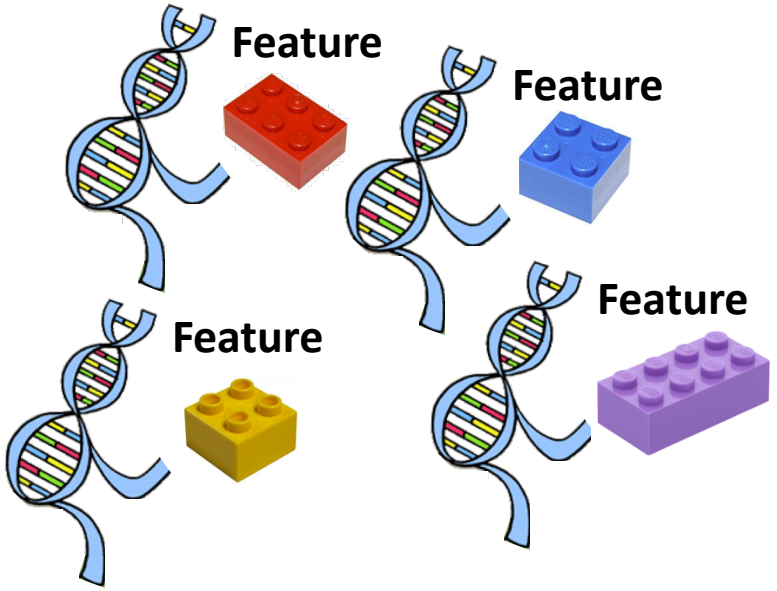
Francisca Pérez

Jaime Font

Lorena Arcega

Carlos Cetina

The EA locates Features (building blocks) for systematically assembling products:



Software Product Line

Software Product Lines are very appealing

Documented real-world examples of the benefits of Software Product Lines:

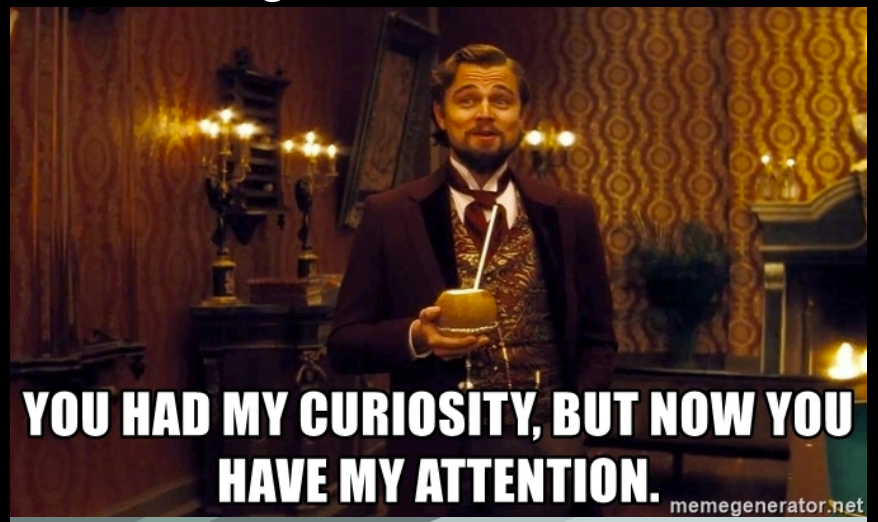
- savings of $584 million in development costs
- a 2x-4x reduction in time-to-market,
- a reduction in maintenance costs of around 60%

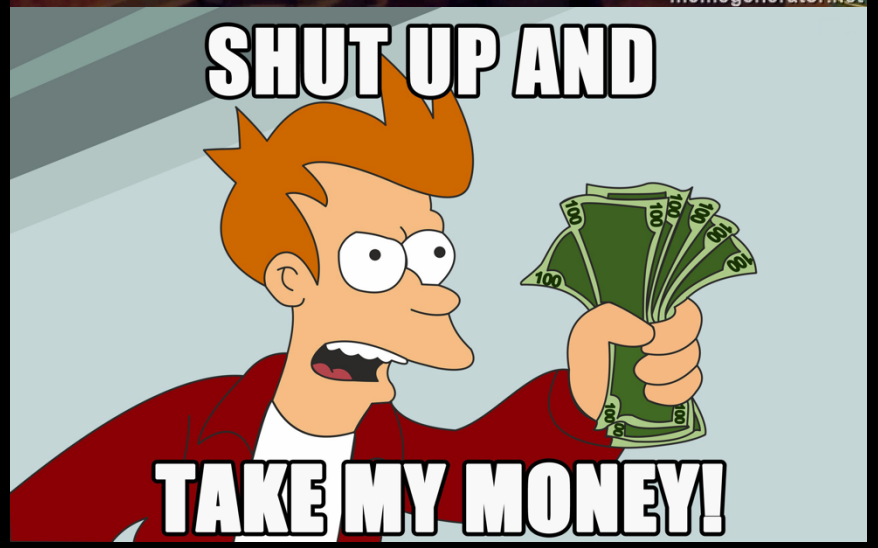
And the list goes on and on:

large-scale productivity gains
increased product quality
decreased product risk
increased market agility
increased customer satisfaction
ability to effect mass customization
more efficient use of human resources
ability to maintain market presence
ability to sustain unprecedented growth

Carnegie Mellon University
Software Engineering Institute

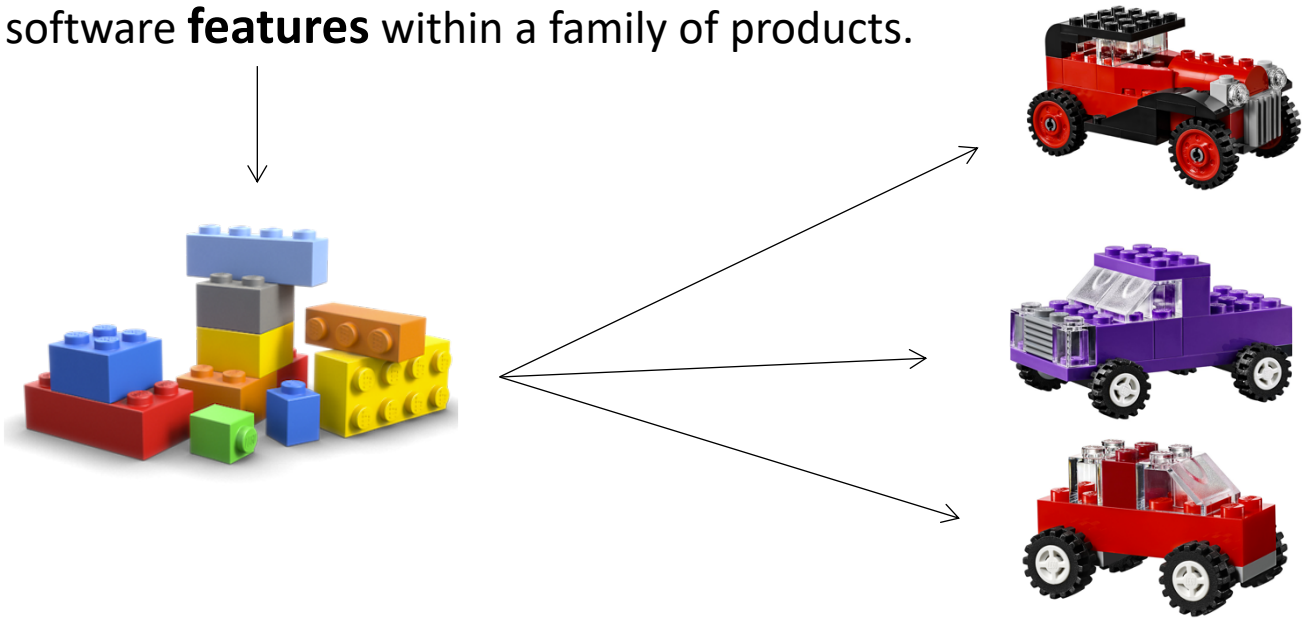
Organisations' reactions





However, there is a big catch!

Software Product Lines are all about reusing software **features** within a family of products.

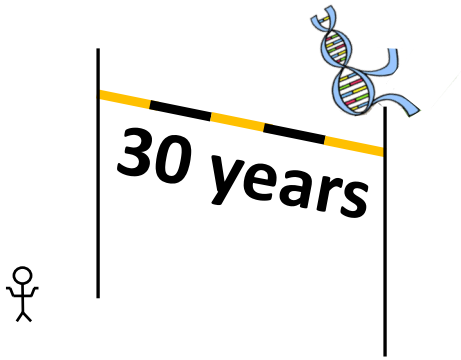


The entry barrier is locating the features in the first place!

30 years **of work by a single engineer**

was the estimation for locating the software features of a real-world train manufacturer* as reported in our paper

*in business since 1917

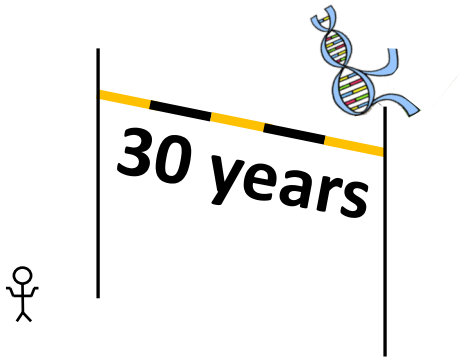


Our results are human-competitive

1

- A **human expert** is one of the baselines **outperformed** by our approach.
- Our results have **replaced solutions** created by human experts in real world industries over a long period (13+ years).

(E) The result is equal to or better than the most recent human-created solution to a long-standing problem for which there has been a succession of increasingly better human-created solutions.



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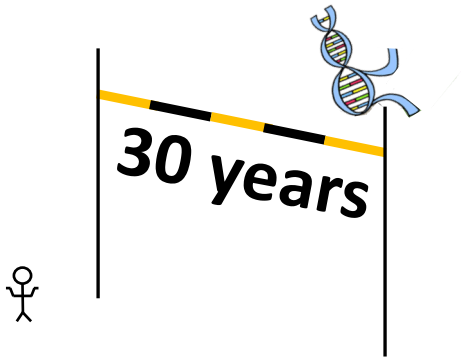
- The research community keeps a **database** of successful product line adoptions and **our results include successful adoptions**.

(C) The result is equal to or better than a result that was placed into a database or archive of results maintained by an internationally recognized panel of scientific experts.



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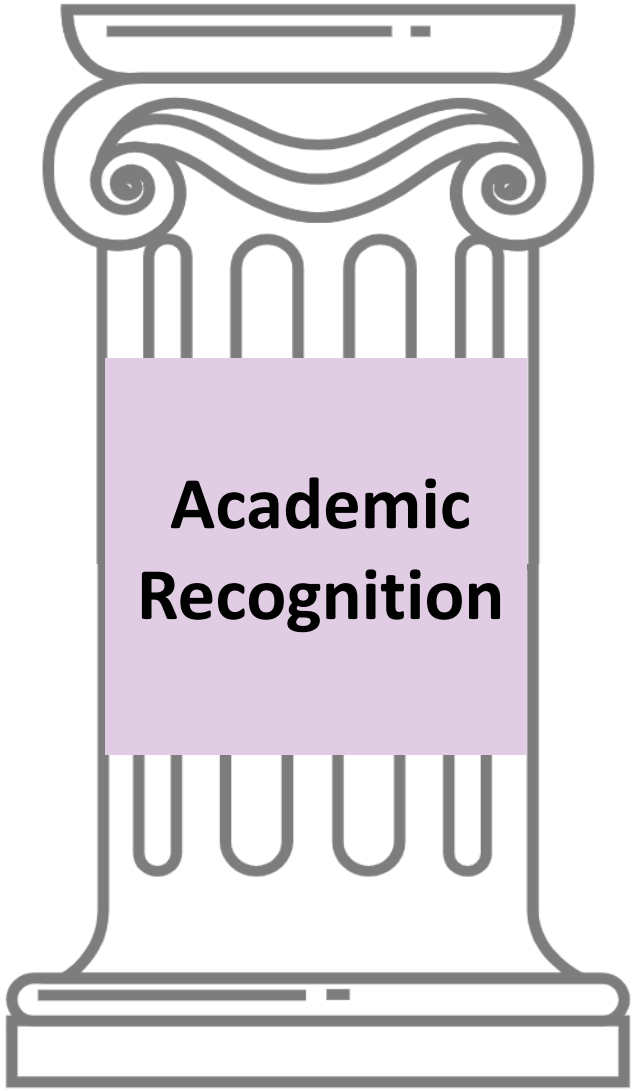
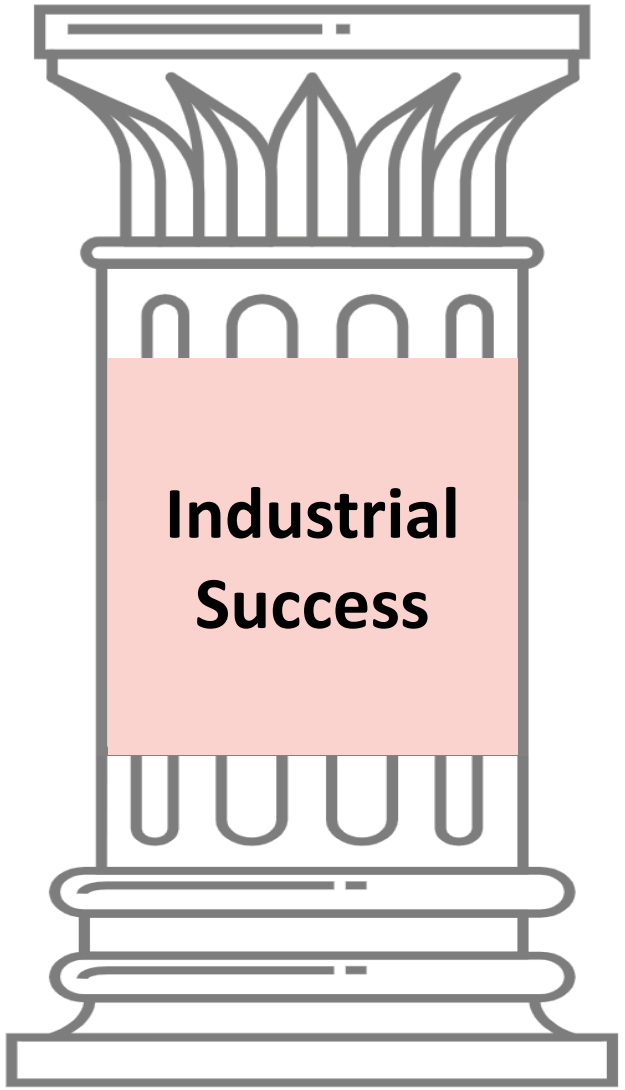
3

- **International organizations** have based their business on Software Product Lines since 1999.
- Research in the field of feature location indicates that this is **a non-trivial problem.**

(G) The result solves a problem of indisputable difficulty in its field

Why *our* entry is the “best”





Academic Recognition

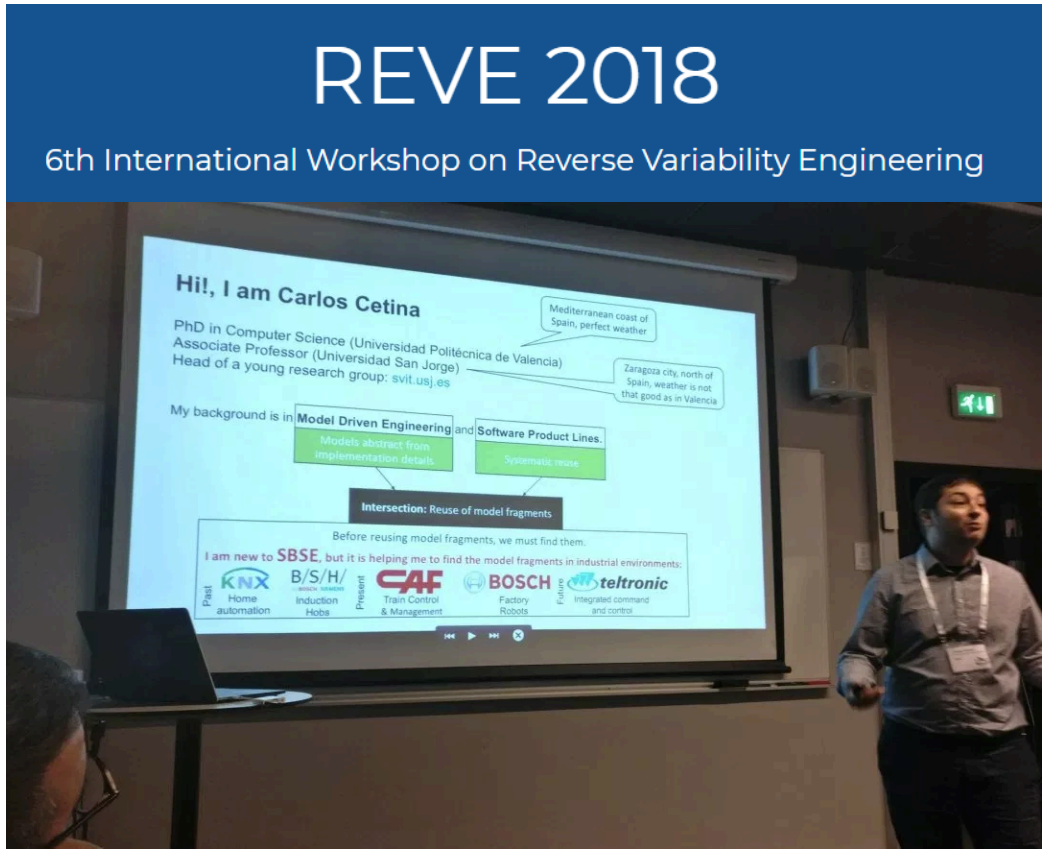
Accepted in a leading Software Engineering Journal:
Automated Software Engineering

One of the reviewers stated:
“Collaborative feature location (i.e., taking multiple feature descriptions as input) is **a new dimension to this problem**”

Another reviewer stated:
“The detailed explanation provided in the paper also clearly shows the need for this approach, as **the manual work would otherwise be daunting** for developers”

Academic Recognition

Invited to present this work as keynote speaker



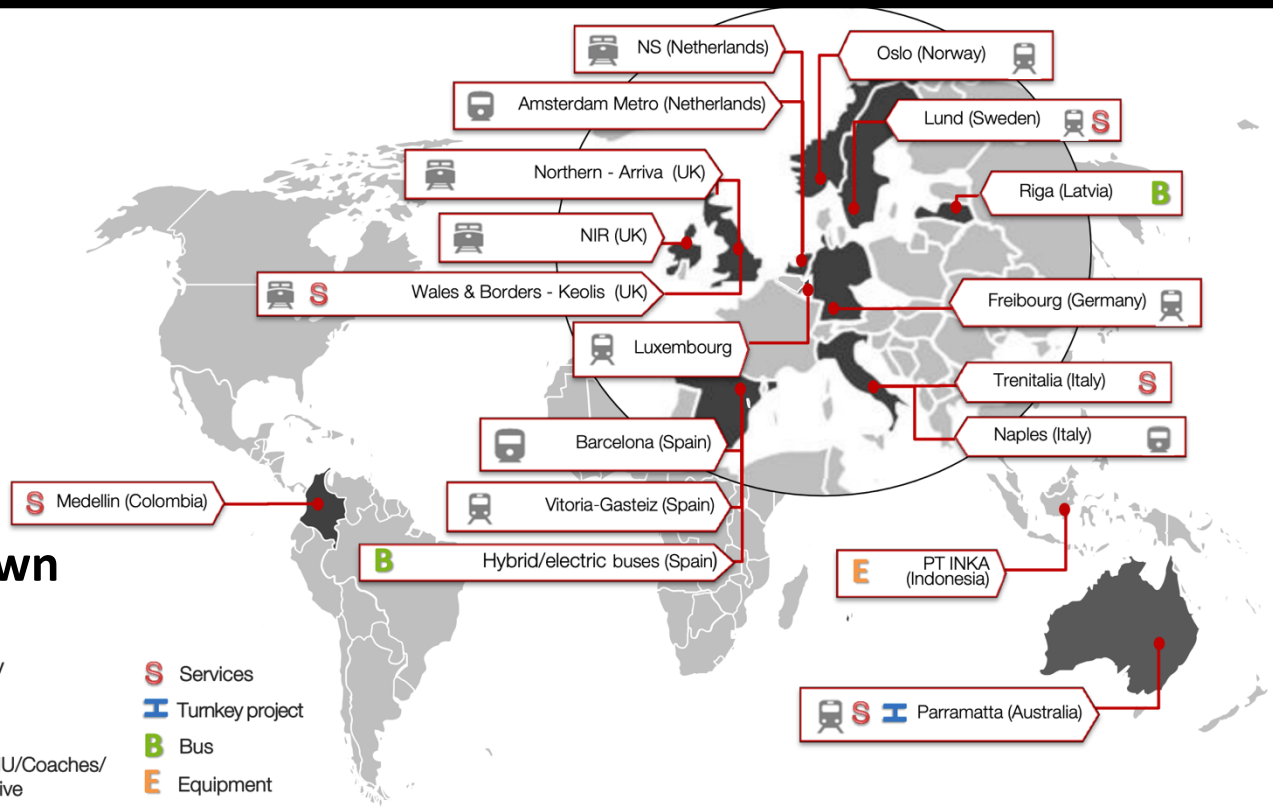
Invited to contribute 2 chapters about this work to

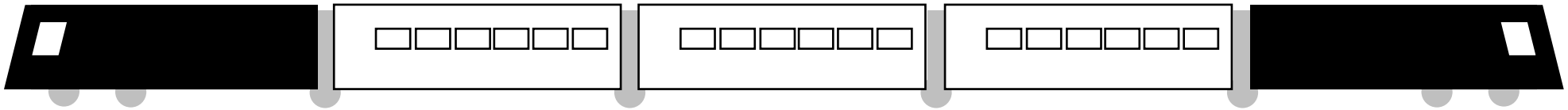
Arguably the most relevant forum and book for reengineering software intensive systems into software product lines.

Industrial Success

Train Control and Management

- top-6 manufacturer of trains worldwide
- in business since 1917
- **Engineers prefer to use our features instead of their own**
- features located in legacy trains and applied to new trains:





Train Bus

Train PLC

Software Features:

brakes, traction, lights, CCTV, batteries, doors, diagnostics, AC, PA, coupling…

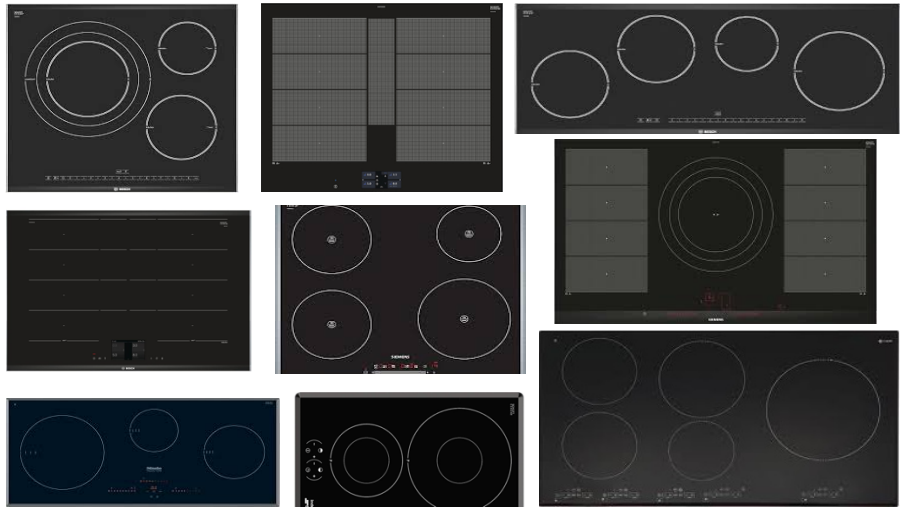
Industrial Success

B/S/H/
BOSCH AND SIEMENS HOME APPLIANCES GROUP

Induction Hobs

- top European manufacturer, and top-3 world manufacturer
- **their long-standing (13+ year) features replaced by our features**

- Memorable statement from a BSH software engineer:
  “Your tool has changed my life for the better”



BOSCH SIEMENS GAGGENAU NEFF
Thermador Balay Coldex Constructa
PITSOS PROFILO ufesa zelmer
JUNKER viva

Induction Hob Microchip
Software Features:
dynamic cooking zones, user feedback, temperature control, energy boost…

Industrial Success

B/S/H/
BOSCH AND SIEMENS HOME APPLIANCES GROUP

also plans to extend application of our features to the software of their factory robots

At the moment, this new application is under evaluation within H2020 European funding programme

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teltronic
a Hytera company

- world leader in the design and manufacture of mission-critical radio communications
- is **demonstrating interest in applying our work**

Infrastructure

Subscribers

On-board Radio

Why *our* entry is the "best"

Academic Recognition

Leading software journal

Reviewers: "new dimension" and "otherwise daunting"

Invited to Keynote

Invited to Springer Handbook

Most relevant forum and book

Industrial Success

Top-6 world leader manufacturer of trains (CAF)

Top-3 world leader manufacturer of induction hobs (BSH)

☺

BSH factory robots: under evaluation within H2020

World leader in mission-critical communications (Teltronic): formal interest expressed

Replaced long-standing human solutions

Life changer!

Thanks!

To learn more visit:
svit.usj.es
SVIT Research Group

Francisca Pérez

Jaime Font

Lorena Arcega

Carlos Cetina