

## CALL FOR "MY BEST PROJECT" - XVII SUMMER SCHOOL FRANCESCO TURCO

**REMINDER: SUBMISSION CLOSES NEXT 31 JULY**

Dear Colleagues and Friends,

the Organizing Committee of the Summer School "F. Turco" would like to invite you to submit your "My Best Project" Poster.

The objective is encourage Researchers to present and disseminate a research project particularly interesting for its innovation, applicability, future development. The initiative is particularly interesting for the presence of many industrial managers at this edition of Summer School

Special thanks to Prof. M. Garetti who suggested this new challenging initiative.

**Poster should be sent by 31 July**

- **In paper form (A0 format) to Dpt. Tecnica e Gestione dei Sistemi Industriali, Stradella San Nicola, 3, 36100, Vicenza (c.a. Alessandro Persona).**
- **By email in a pdf format to [info@summerschool-impianti-unipd.it](mailto:info@summerschool-impianti-unipd.it)**

### "MY BEST PROJECT" POSTER ATTRIBUTES

Poster should be attractive and beautiful at view. So be clear and tidy, try to explain concepts by graph or schemas instead of too much words and tables, pay attention to not fill up the whole space.

Don't worry to explain all concepts in a too much detailed way, but try to concentrate just on the main core idea. There is already a thesis work or a technical paper to state everything about the work content.

### SECTIONS IN THE POSTER

The poster should be divided in different sections (see figure) each one focused on a part of the work, follow the logical order of the subsections already defined in the sample case (please note that the object of the sections can vary according to different type of project [i.e.: development or a measurement system, implementation of a computer program, surveys, etc]):

1. SECTION 1 - problem statement/state of the art: describe why this project/thesis was developed and/or state the previous research in the field;
2. SECTION 2 - project idea: speak about the core idea of the project, how is this developed? and (if any) what are the difficulties to be solved?
3. SECTION 3 – deployment: state how you implemented the project idea, and (if any) how the problems presented in the previous section are solved;
4. SECTION 4 - results/conclusion: describe the achievements of the thesis/project and future developments, (if present) state test results and how they have been carried out.

**Title**

**Your name and email**

**Other authors information**

**Section 1**

**Section 2**

**Section 3**

**Section 4**

**Partners logo**

**Data-fusion algorithms for error mitigation in distance measurements with microwaves**

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**Problem statement**

Design of a measurement system for detecting the span of a crane arm. Reliability of the system is crucial to ensure working conditions.

Designing a crane arm length measurement system must respect some constraints:

- Contactless measurement system (contact measurement equipments have drawbacks and high cost)
- Good reliability
- Low cost
- Capable to work in indoor (no GPS), outdoor and dusty environments (no laser)

**Project idea**

Wireless technology is used for the measurement system which is based on the measure of the time that a microwave signal takes to flight from one sending antenna to a receiver one (this being able to avoid the previous order condition and requirements).

The wireless measurement system approximates the flight time (time of arrival) between the antennas, distance is later calculated by the formula:

$$d = TOA \cdot v_{light} \quad (1)$$

Where:  
 $d$ : distance between the antennas  
 $TOA$ : propagation delay or time of flight  
 $v_{light}$ : light speed (constant)

In the real application case  $d$  is measured and the length value  $d'$  must be stated by the formula:

$$r = d + n + NLOS \quad (2)$$

Where:  
 $d'$ : the real distance between the pair of antennas;  
 $n$ : hardware measure noise;  
 $NLOS$ : Non Line Of Sight; positive bias environment dependent

Representation of the possible communication path between two antennas, one that in this case LOS (line of sight) path isn't available but there are NLOS (non line of sight) and non path contribution

**Deployment**

The evaluation and the mitigation of NLOS error (need for solving (2)) is obtained by merging two independent signals: time of flight and acceleration of the arm.

An extended Kalman filter (EKF) is used to merge line-of-flight and acceleration signals, and to compute time offset or distance output.

Accuracy is measured by playing an embedded device (it also transmit information on the wireless network) on the end-effector.

**Results**

All algorithms have been tested in different condition and with different types of antennas. EKF3 and planar antenna achieved the best performance.

Algorithms have been tested with three types of antennas:

- Omnidirectional antenna
- Yagi-Uda type directional antenna
- Planar type directional antenna

During the test the crane was operating both indoor and outdoor industrial environments.

EKF 3 algorithm achieved better performance in terms RMSE and maximum error than other algorithms. In particular with planar type antenna it achieved the best performance. EKF 3 algorithm proved not to be reliable. EKF 3 algorithm provided sufficient performance, requiring further improvements for adoption.

**Performance:**

Plan: RMSE 0.07 m - Max 0.3 m  
 Yagi: RMSE 0.08 m - Max 0.3 m  
 EKF 3: RMSE 0.12 m - Max 0.3 m

Try to balance each sections according to the work you have done, but be careful to not oversize one compared to the others.

Remember to complete the other sections shown in figure.

At the begin of each subsection write some sentences to summarize what you are going to describe, a reader should know what he/she's going to read in the whole subsection and know the core idea just from these summaries.

## TEXT DIMENSION AND IMAGE QUALITY

Use bold and italics to give emphasis to the main concepts and key words.

Poster should be clearly readable from 1 m, so try to use clear font (example: arial, Calibri, etc) use a font size of about 26 for the text. Suggested paper size is A0 (don't worry if it seems too big: it's easy to reduce dimensions to A1 or less when you print from a pdf file format).

The pictures, graphs and any other image-format objects should be in high resolution, otherwise the printed results could be of bad quality (visible pixels).

## SUGGESTIONS ON EDITOR TO USE

The template you can find in the same folder of this text ("my best project example.pub") is created using Publisher 2007 (Microsoft Office 2007), but if you prefer you can use other different software (i.e. Power point or open source ones).

You can also download the template at:

<http://www.summerschool-impianti-unipd.it/my-best-project-presentation.html>

In absence of poster style indication: please use similar font, page layout, lines and colors style as the template.

## SUGGESTIONS ON PRINTING FORMAT/SUPPORT AND PRINT SHOP

When you have completed the editing phase of the work try to print a copy on a A3 format (or A4) to have an idea of the final results, if it seems fine create a pdf file of your poster: in publisher go to File->Publish as a pdf. Otherwise install on your pc a "virtual printer" to create a pdf (search on the web how to do it).

WARNING 1: what you see in pdf is exactly what you'll have printed on paper, so check this file.

WARNING 2: in order to have a good printed results image and graph should be in high quality.

**For printing go to the print shop and ask for an "A0 printing on a vinyl support"** ("stampa in A0 su supporto plastico in vinile"\*) they'll ask you the pdf file to print.