

## Presentation Instructions

Your paper has been assigned as either a lecture or a poster presentation. At ICIP, papers are scheduled into lecture and poster sessions based on thematic coherence rather than by paper quality. In either case, the full, 5-page paper appears in IEEE Xplore, and there is no indication in Xplore as to whether the paper was presented orally or as a poster.

### Lecture Presentations

**PRESENTATION TIME:** Presentation time is critical; each paper is allocated 20 minutes for lecture sessions, including time for questions, session-chair introductions, and any set up that is not completed in advance. We recommend that the presentation of your slides take about 16 minutes, leaving 4 minutes for introduction by the session chair and questions from the audience; in any event, your presentation must not exceed 17 minutes. To achieve appropriate timing, organize your slides around the points you intend to make, using no more than one slide per minute. A reasonable strategy is to allocate about 2 minutes per slide when there are equations or important key points to make, and one minute per slide when the content is less complex. Plan on covering at most 6 points per slide, using 6 to 12 spoken sentences and no more than about two spoken minutes. Be prepared to begin your presentation as soon as the prior presenter has finished; it is important to keep on schedule.

**ORGANIZATION OF IDEAS:** Slides attract and hold attention as well as reinforce what you say — provided you keep them simple and easy to read. Make sure that each of your key points is easy to explain with aid of the material on your slides. Do not read directly from the slide during your presentation. You should not need to prepare a written speech, although it is often a good idea to prepare the opening and closing sentences in advance. It is **very** important that you rehearse your presentation in front of an audience before you give your presentation at ACEMP. Presenters **must** be sufficiently familiar with the material being presented to answer detailed questions from the audience.

**PRIOR TO YOUR PRESENTATION:** Come to the room during the break immediately prior to your session and upload your presentation to the computer in the room. Note: the presentation computer has **ONLY a USB port**; there is no CD-ROM or other disc drive. You must also meet with your Session Chair at this time so that your Session Chair is aware that you are present; your Session Chair may also have last-minute instructions for your presentation.

## **PLEASE bring a short CV with you to help the chair present you to the audience**

**EQUIPMENT PROVIDED:** All lecture rooms will be equipped with a computer, a video projector, and a microphone. Each computer will have a USB port; there will be no other equipment available.

Each computer will have a recent version of the Windows OS installed as well as Acrobat Reader software.

While Powerpoint will also be provided, presenters may use PDF for their presentations to avoid issues with fonts and other problems. Remember to embed all your fonts into your PDF presentation.

Pay attention to the following critical points:

- Make sure your presentation does not run into a problem on the Windows 7 platform if you are a Mac or Linux user
- If you will be playing video or animated media, make sure it runs on Windows Media Player
- Embed all the fonts in your presentation

Keep in mind that some of the oral presentations will be given in lecture halls that are quite large. When preparing your slides, make sure that they will be legible for the entire audience (i.e., use fonts of sufficient size).

### **📄 Poster Presentations**

**DIMENSIONS:** For your poster, a board will be provided; the board is oriented in a “portrait” format and has dimensions of 90cm wide and 120cm tall (approximately 35in wide and 47in tall. Posters should not be larger than A0 paper size). Push tacks or velcro adhesive will be provided at the conference to mount your poster to the board.

**ORGANIZING YOUR POSTER:** Poster sessions are a good medium for authors to present papers and meet with interested attendees for in-depth technical discussions. In addition, attendees find the poster sessions a good way to sample many papers in parallel sessions. Thus it is important that you display your message clearly and noticeably to attract people who might have an interest in your paper.

Your poster should cover the key points of your work. It need not, and should not, attempt to include all the details; you can describe them in person to people who are

interested. The ideal poster is designed to attract attention, provide a brief overview of your work, and initiate discussion. Carefully and completely prepare your poster well in advance of the conference. Try tacking up the poster before you leave for the conference to see what it will look like and to make sure that you have all of the necessary pieces.

ABOVE THE TITLE PLEASE WRITE the following and center

**ACEMP-OPTIM-ELECTROMOTION 2015 SIDE TURKEY 2-4 september 2015**  
FONT SIZE :36 ARIEL

The title of your poster should appear at the top in CAPITAL letters about 25mm high. Below the title, place the author(s)' name(s) and affiliation(s). The flow of your poster should be from the top left to the bottom right. Use arrows to lead your viewer through the poster. Use color for highlighting and to make your poster more attractive. Use pictures, diagrams, cartoons, figures, etc., rather than text wherever possible. Try to state your main result in 6 lines or less, in lettering about 15mm high so that people can read the poster from a distance. The smallest text on your poster should be at least 9mm high, and the important points should be in a larger size. Use a sans-serif font (such as "cmss" in the Computer Modern family or the "Helvetica" PostScript font) to make the print easier to read from a distance. Make your poster as self-explanatory as possible. This will save your efforts for technical discussions.

**PRESENTING YOUR POSTER:** Prepare a short presentation of your paper which you can use to emphasize the highlights of your work in a few minutes.

Please put up your poster during the break before your session starts, and take it down immediately after your session ends. Each poster session is 2 hours long; a presenter must be present at your poster during the entirety of the session. If possible, more than one author should attend the session to aid in presentations and discussions, and to provide the presenters with the chance to rest or briefly view other posters.

**Comparison of Outer Rotor Radial Flux and Axial Flux PM Motors for Control Moment Gyroscope Application**

H. Bülent Ertan  
Middle East Technical University Ankara Turkey

Xxxxx Çakan  
XXXXX Industries

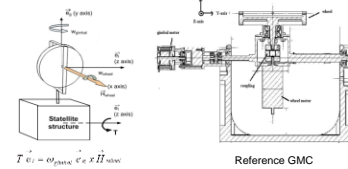
**Abstract**

Control moment gyroscopes (CMG) are used in modern satellite applications for attitude control of satellites. The volume and mass of the instruments is very important in such applications. In this context, integrating the mass of the CMG, on the stator of the motor, promises to save space and mass. Radial-flux outer-rotor motor is a promising configuration in that respect. In this paper, using such a PM motor is considered for control moment gyroscope applications. The design of the motor must be made such that the specifications, such as accelerating torque, steady-state torque and temperature rise constraint should be taken into consideration, while the mass and volume are kept at minimum. This is a difficult problem to solve. This paper presents an approach for designing the motor to meet these criteria. The findings indicate that the outer-rotor, radial-flux motor based CMG has important advantages and while the mass of the CMG can be reduced to 2/3 of the reference design, the volume is reduced to 1/5 of the reference design.

**The problem**

Control moment gyroscopes (CMG) are used in satellite attitude control.

Volume and mass of instruments are critical in space applications



Integration of the inertia wheel with the motor offers advantage

**Materials of design**

- Laminations 0.5 mm 1.09 W/kg loss at 1T at 50 Hz
- Magnet material:
  - Permanet magnet
  - Low temperature sensitivity
  - High corrosion resistance
  - Low radiation sensitivity Required
  - Samarium Cobalt is suitable

**Outer Rotor PM Motor Solution**

- Create a magnetic circuit equivalent
- Assume that the magnetic circuit is operating in the linear region

**Design Equations**

$$\tau_p = \frac{\pi^2}{4\sqrt{2}} B_{gav} q D_i^2 L \quad B_{gav} = \phi_{pole}/A_{pole} \quad q = 6NI/\pi D_i$$

**Constraints**

Current Density  $j = 7 \text{ A/mm}^2$  at steady state  $3 \text{ A/mm}^2$   
Average flux density is kept at  $B = 0.43 \text{ T}$   
Maximum flux density is limited to  $1.4 \text{ T}$  (linear region)

**Determination Of Dimensions To Meet Criteria**

**Specifications**

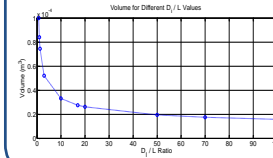
Inertia  $4.83 \times 10^{-4} \text{ kg/m}^2$   
Speed  $10\,000 \text{ rpm}$   
Efficiency greater than  $78\%$   
Torque  $32 \text{ mNm}$  max  $50 \text{ mNm}$

**Independent dimensions:**

slot height  $h_s$   
Rotor diameter  $D_r$  and core length  $L$   
Tooth width is assumed to be equal to slot width

There are only 2 constraints Current density  $J$  and  $B_{gav}$   
Design must be made to meet these 2 constraints  
So the independent variables are reduced to 2 by defining  $R_{DL} = D_r/L$

$R_{DL}$  is allowed to vary between 0.7 to 17



Parameters	AF 6-pole	Existing RF	Outer-Rotor 2-pole
Mass of wheel	386.6	533	377
Volume of wheel	3.49E-04	8.36E-04	1.68E-04
Efficiency	92	78	95.60%

**Conclusions**

Outer-Rotor radial-flux motor provides a good solution for CMG application  
Compared to the reference design volume is reduced to 1/5<sup>th</sup> and mass 2/3<sup>rd</sup>