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# A new model for conference submissions

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**Abstract.** Electronic submission to a conference is a process that is known to evolve nonlinearly in time, with a dramatic increase when approaching the deadline. A model has recently been proposed by Alfi *et al.* (Nature Physics, 2007) for such a process, and the question of its universality has been raised. This problem is revisited here from a data analysis and modeling point of view, on the basis of a larger data set. A new model is proposed that better describes the complete evolution of the process (including saturation) and allows for a running prediction of the total number of submissions.

**PACS.** PACS-89.75.Fb Structures and organization in complex systems – PACS-89.20.Hh World Wide Web, Internet

## 1 Introduction

For anyone who ever organized a conference, it is well-known that most of the electronic submissions are to be expected during the very last days (or even hours) before the deadline. This folklore observation has recently received a more quantitative attention [1], ending up eventually with a possible model (referred to in the following as “APP”, for Alfi-Parisi-Pietronero) for the submission process prior the deadline and suggesting its possible universality. The analysis proposed in [1] was based on a very simple assumption (the probability of submission was assumed to be inversely proportional to the lasting time before the deadline) and it resulted in a model that fitted remarkably well the analyzed experimental data. At this point, two remarks can however be made:

1. The first one is related to the APP model itself which, strictly speaking, predicts a finite time singularity in the form of a logarithmic divergence when approaching the deadline (see Sect. 3.1 below), a property that has to be regularized in some way since, in practice, the total number of submissions has always to be finite. As a corollary, the prediction of this number is not easy, and the rule of thumb proposed in [1]—i.e., extending the initial linear increase of the early submissions and multiply by three the intersect at the deadline—was seemingly *ad hoc* and not a direct by-product of the model.
2. The second remark concerns the supporting data which essentially consisted in only one major conference and one more local workshop. Whereas the proposed mod-

eling was clearly relevant for such data, it is obvious that more examples would be needed for assessing some form of universality in the reported behaviour. Moreover, it is likely that the results might also depend on the type of conference considered and/or on the concerned scientific community.

In order to address those issues, another (somehow larger) set of data is envisioned here. This data set is first described in Sect. 2, whereas a visual inspection of the corresponding time series will suggest a refined model (as compared to the APP one) that is discussed in Sect. 3, in both terms of fit and prediction of the total number of submissions. Finally, interpretation issues and still open questions about universality will then be addressed in Sect. 4.

## 2 Data

The data set considered in this paper consists in the timestamps of electronic submissions to six conferences that play a major role in the signal and image processing (SIP) community:

- Three of them are organized at a national level (the GRETSI symposia which are, every two years and under the auspices of the GRETSI association [2], the largest French-speaking event);
- One at the European level (the European Signal Processing Conference EUSIPCO that takes place every year and is organized by the EURASIP association [3]);
- Two at a worldwide level (a more specialized biennial workshop: the IEEE Statistical Signal Processing Workshop SSP, and a very big annual convention: the

**Table 1.** Actual numbers of submissions of the considered conferences, estimated parameters of the proposed model and predicted total number of submissions (see Sect. 3.2). In some cases, the initial deadline has been officially extended and results corresponding to both deadlines are reported.

conf.	G-03	G-05	G-07	E-04	S-05	I-06
# subm.	423	462	481	876	438	3903
$\beta$	2.6	2.5	1.6	1.6	1.3	1.7
	2	-	-	1	1.3	-
$t_*$ (days)	0.25	-0.1	-2	2	1	-0.4
	-1	-	-	-0.2	-1.5	-
1 week pred.	410	451	487	894	456	4078

IEEE International Conference on Acoustics, Speech and Signal Processing ICASSP, which is by far the most largely attended conference in the field, both events being organized by the IEEE-SP Society [4]).

More precisely, locations and dates of the conferences analyzed here are as follows:

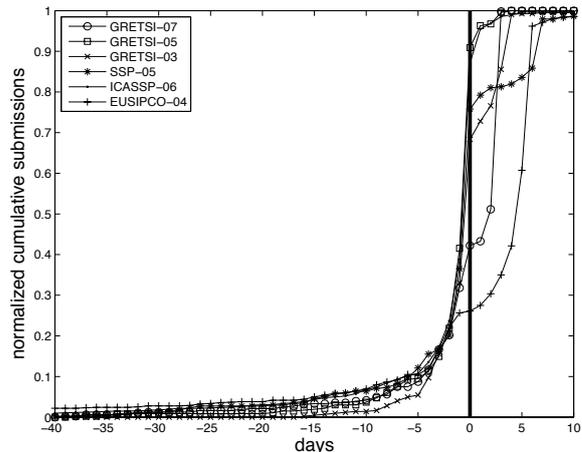
- GRETSI-03, Paris (F), Sept. 8-11, 2003
- GRETSI-05, Louvain-la-Neuve (B), Sept. 6-9, 2005
- GRETSI-07, Troyes (F), Sept. 11-14, 2007
- EUSIPCO-4-03, Vienna (A), Sept. 6-10, 2004
- SSP-05, Bordeaux (F), July 17-20, 2005
- ICASSP-06, Toulouse (F), May 14-19, 2006

Details of the corresponding total numbers of submissions are given in Table 1.

In all cases, the data have been recorded from the opening of the submission websites to their closing, this latter taking always place later than the deadline initially announced. Timestamps are given in UNIX time and thus known with a precision of one second, but their analysis has been carried out with no noticeable difference either on the basis of all timestamps with their actual time locations or on a smaller subset corresponding to the situation of submissions at regularly spaced intervals (typically one day). For a sake of simplicity and readability, the results reported here will correspond to such uniformly sampled time series, with about fifty samples in each case, corresponding to a submission period that is generally of the order of two months.

In terms of specificity, all the chosen events can be considered as attended by essentially the same (SIP) scientific community, which certainly differs from that attending the conference StatPhys 23 considered in [1]. Moreover, whereas submission to StatPhys meetings consists in sending a short abstract only, submission to those SIP conferences implies the sending of a much more complete material, namely the full paper (4 or 5 pages, double column) in the case of ICASSP or EUSIPCO, and an extended summary (3 or 5 pages, single column) for GRETSI or SSP. This is likely to impact on the timing of submissions, with a tendency to skew the distribution towards shorter time distances from the deadline.

While diverse in size, the considered conferences can however be viewed as representative of a common situa-



**Fig. 1.** Cumulative number of submissions as a function of time. All data have been renormalized by their corresponding total number of submissions so as to saturate at unity, and shifted relatively to a deadline arbitrarily fixed at  $T = 0$  so as to superimpose in the regime prior the first announced deadline. Variations after  $T = 0$  correspond to extended deadlines.

tion in terms of field, community and style, and the analysis of the different submission histories reveals indeed striking resemblances. This is reported in Fig. 1 where, after a renormalization by the total number of submissions (and some possible deadline shift that will be commented later), all data points are found to fairly well superimpose on a common curve prior the deadline, here referred as time  $T = 0$  (an even better superimposition could be obtained by adjusting a scale factor on the time axis as proposed in Sect. 3.2, but this has not been done here). The dissimilarities occurring after  $T = 0$  are due to deadline extensions (3 days or 1 week, announced just before the initial deadline), and it striking to observe that, when taking into account the corresponding shifts, the same type of behaviour is recovered.

In short, the submission process can be depicted by a nonlinear evolution that is highly accelerated when approaching the deadline and slowly relaxed for late submissions (when still accepted).

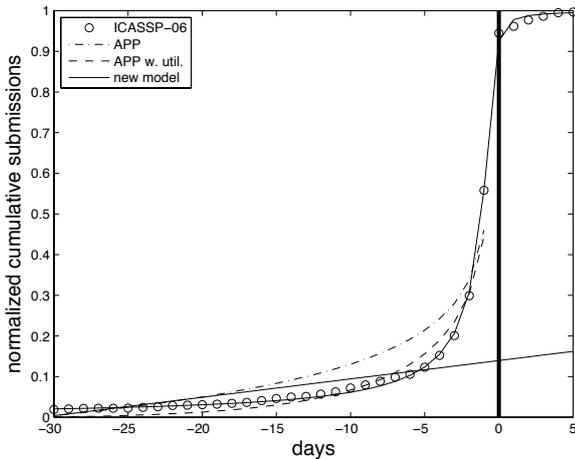
## 3 Models

### 3.1 APP

Up to the saturation effect, evolutions such as those in Fig. 1 were supposed to be captured by the APP model. Indeed, this latter assumes that the “probability” of submission at time  $t$  is inversely proportional to the remaining time up to the deadline  $t_*$ , thus reading:

$$p(t) = \frac{C}{t_* - t}, \quad (1)$$

where  $C$  is some constant related to the total number of submissions.



**Fig. 2.** Data and optimal least-squares model fits in the case of ICASSP-06. The new model, (fitted for all times, including after the deadline referred to as  $T = 0$  (thick line)) is compared to the APP model which holds prior the deadline only, with and without an exponential utility function (whose fitted time scale happens to be of about 14 days). The thin straight line corresponds to the extension of a linear fit on the early part of the APP model, its intersect at  $T = 0$  corresponding, when multiplied by 3, to the APP rule of thumb for the prediction of the total number of submissions.

It thus follows that the number of cumulative submissions  $N(t)$  at time  $t$  is expected to be of the form

$$N(t) = \int_0^t p(s) ds = C \log \left( \frac{t_*}{t_* - t} \right), \quad (2)$$

predicting a logarithmic divergence at  $t = t_*$ .

Even if ignoring the necessary regularization of this divergence, such a model does not account properly for the present data, as evidenced in Fig. 2 where a fit according to eq. (2) cannot adequately reproduce the global evolution from early submissions to late ones (ICASSP-06 has been chosen as an example because it corresponds to the largest data set, but a similar behaviour is observed with the other conferences). Moreover, applying the APP rule of thumb for prediction would lead in all cases to a total number of submissions that is largely under-estimated (e.g., by a factor of almost 3 in the case of ICASSP-06).

As suggested in [1] for payments as opposed to registrations, an exponential “utility function” could be added to the model in order to take into account a “pressure” to postpone the submission. While certainly improving the situation in terms of fit prior the deadline (see Fig. 2), this however does not solve the divergence issue when approaching  $t_*$  nor it offers an easy way of making predictions about the total number of submissions.

### 3.2 An empirical model

All those observations prompt to look for some more effective model, capable of reproducing at once the global

behaviour, including the saturation. The main characteristics that is looked for is therefore some nonlinear, sigmoid-type evolution, as commonly observed in many growth phenomena. Warped sigmoid-based models (such as, e.g., those derived from the Richards growth equation [5]) turn however not to be adapted whereas better candidates (see, e.g., [6]) suffer for not having any analytic expression for the integrated growth equation. From a pragmatic point of view, a very simple and convenient model for the cumulative number of submissions  $N(t)$  as a function of time  $t$  turns out to be:

$$N(t) = \frac{1 - \exp\{\tan^{-1}[\beta(t_* - t)] - \pi/2\}}{1 - \exp\{-\pi\}} N_{tot}, \quad (3)$$

where  $N_{tot}$  stands for the total number of submissions and  $\beta$  is some time scale factor.

### 3.3 Fit

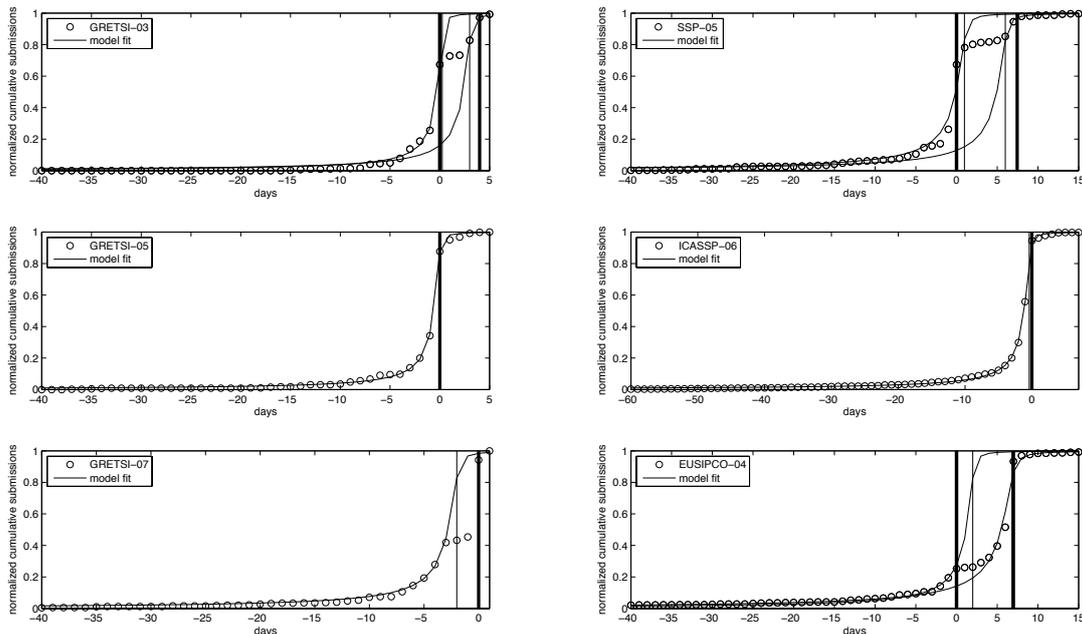
As evidenced in Fig. 2, fitting (in a least-squares sense) the model of eq. (3) to the largest data set (ICASSP-06) is very satisfactory.

In terms of modeling, one could think of the actual deadline  $T = 0$  as a fixed quantity, but it is in fact more natural to consider it as a free parameter. This allows for an increased flexibility that may take into account possible deadline extensions as well as (personal) “targeted” deadlines that may differ from the actual one. Fitting this way the proposed model (3) with 2 degrees of freedom (the scale factor  $\beta$  and the effective deadline  $t_*$ , the total number of submissions  $N_{tot}$  being assumed to be known) to the whole data set corroborates the results obtained in Fig. 2 for ICASSP-06. This is evidenced in Fig. 3, with the corresponding numerical values of the estimated scale factors  $\beta$  and effective deadlines  $t_*$  reported in Table 1 (in the three cases where the initial deadline has been officially extended, two models have been adjusted, with an estimated deadline fitted in the vicinity of each actual one).

One can remark that the values of the scale factor  $\beta$  have some variability, ranging from 1 to 2.6. However, in the case of SSP-05, it is interesting to point that the same value ( $\beta = 1.3$ ) is obtained whatever the considered deadline (initial or extended), supporting the interpretation that the one week deadline extension resulted mostly in a pause of the same amount of time in the submission process. Similar (even if less striking) observations can be made for the two other conferences (GRETSI-03 and EUSIPCO-04) whose deadline has been extended with an official announcement.

### 3.4 Prediction

In practice, the total number of submissions  $N_{tot}$  is of course one extra degree of freedom in any model. In this respect, (3) is of particular relevance in the prediction problem for which, given the knowledge of past submissions



**Fig. 3.** Data and optimal least-squares model fits for all conferences. Actual (resp. fitted) deadlines are plotted as thick (resp. thin) vertical lines. In three cases (GRETSI-03, SSP-05 and EUSIPCO-04), the initial deadline has been officially extended, with an announcement a couple of days prior the initial deadline here referred to as  $T = 0$ . In those cases, two models have been adjusted, with an estimated deadline fitted in the vicinity of each actual one. The corresponding values of the fitted parameters are reported in Table 1.

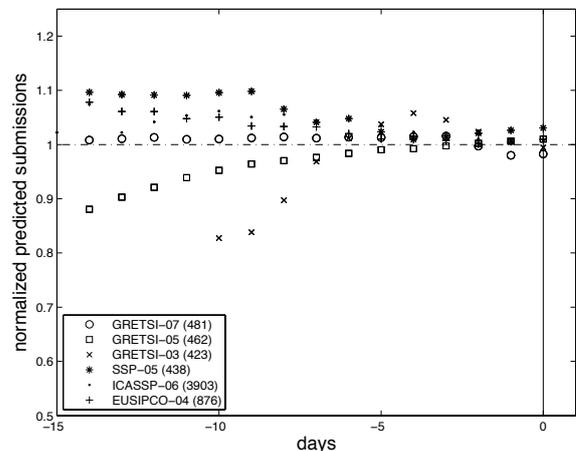
from the opening time of submissions  $t_0$  until the current time  $t$ , i.e.,  $\{N(s), t_0 \leq s \leq t\}$ , the corresponding model fit  $\hat{N}_{opt}(t)$  permits a running average prediction  $N_{pred}(t)$  according to

$$N_{pred}(t) = \frac{1}{t - t_s + 1} \sum_{s=t_s}^t \hat{N}_{opt}(s), \quad (4)$$

with  $t_s$  the initial starting time used for the first estimation of  $\hat{N}_{opt}(t)$ .

Such predictions are plotted in Fig. 4, based on initial estimates starting in each case at  $t_s = t_0/2$ . What can be learned from those curves is that a pretty fair prediction (see Table 1) is possible about one week prior the official deadline, a period of time at which no more that about 10% of the papers are submitted.

Since all predictions have been made under the assumption that the effective deadline should lie in the vicinity of the actual first one (no deadline extension taken into account at this point), a companion outcome of the analysis is that extending the deadline does not really increase the total number of submissions, but rather shifts the usual rush of late ones, as already suggested by Figs. 1 and 3.



**Fig. 4.** Running predictions of the total number of submissions. Results are plotted as a function of time prior the official deadline (vertical line at  $T = 0$ ), after a normalization by the actual total numbers of submissions recalled in the box.

## 4 Conclusion

A new model has been proposed for the time history of conference submissions. It differs from the first (APP) model proposed in [1] in the sense that it includes explicitly a saturation that better describes the observed

evolutions and makes easier a quantitative prediction of the total number of submissions.

From the point of view of conference organizers, the two lessons learned from the conducted analysis are that:

1. They don't have to worry too early about a small number of submissions since, on the average, half of them will be done during the last day (given the model,  $N_{tot}/2$  is attained at time  $t_* - 1.31/\beta$ , and  $\beta$  is typically in between 1 and 3), and a reasonable prediction can be made one week earlier.
2. There is no real point in extending the deadline (at least in terms of number of submissions), unless it is believed that offering more time will end up with better written papers.

While the APP model was clearly relevant for the data considered in [1], the new model turned out to be much better suited to the new data set analyzed here. It is suggested that this is basically due to the different natures of the considered conferences and of the corresponding scientific communities, but this in turn prompts to reconsider from a more critical perspective the issue of universality in people's reaction to a deadline.

More fundamentally, the proposed model is essentially *ad hoc*, thus calling for a more constructive approach that would derive it (or another one, with similar description and prediction power) from well-established basic principles.

Thanks to GRETSI, EURASIP and CMS for accessing the data.

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