

# Physics-informed detection and segmentation of type II solar radio bursts — Supplementary materials

## 1 Preprocessing parameters

- **Gain (g)** — Gain parameter for sigmoid function.
- **Bin width** — Width of each histogram bin during histogram equalisation.

<b>Feature extraction</b>	<b>HOG</b>	<b>Background removal</b>	
Cell size (px)	$4^2$ ( $4 \times 4$ )	Sigma threshold $\lambda$	0.5
Block size (cells)	$3^2$ ( $12 \times 12$ )	Min size (px)	5
Block overlap	$3/4$ ( $3 \times 3$ stride)	<b>Intensity normalisation</b>	
Bins	10	Gain (g)	10
Gamma correction	No	Bin width	$9/1000$
Signed gradients	Yes	<b>Filtering</b>	<b>Mean</b>
Length padding (px)	12	Height (px)	5
Window sigma (px)	8	Width (px)	3
Normalisation	L2-Hys (0.2 clip)		

## 2 Detection and segmentation parameters

- **BG removal** — Use of background removal to refine segmentations.
- **Staging** — Use of a two-stage process during segmentation that refines the initial detections only.
- **Length truncation** — Our augmentation of training samples through sampling multiple combinations results in the length parameter of detection candidates to be overestimated. This parameter is used to correct the overestimation by truncating the length of each candidate ROI.

### 2.1 General detector

	Detection	No BG removal		BG removal	
		No staging	Staging	No staging	Staging
<b>Confidence</b>	0.61	0.96	0.93	0.97	0.98
<b>Voting</b>	6.6	4.7	5	4.2	3.5
<b>Length truncation</b>	50%	40%	40%	40%	40%
<b>Sigma threshold <math>\lambda</math></b>	-	-	-	1	1
<b>Min size</b>	-	-	-	9	9

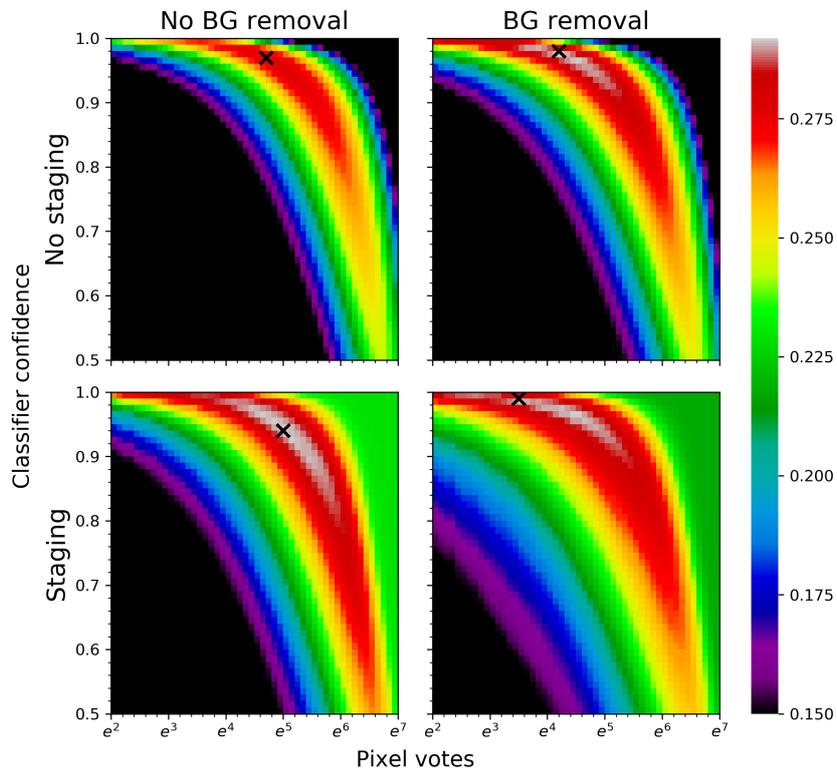
## 2.2 Specialised detectors (using staging and BG removal)

	Low	Medium	High
Confidence (detection)	0.62	0.89	0.75
Voting (detection)	6.9	5.9	6.1
Confidence (segmentation)	0.92	0.93	0.93
Voting (segmentation)	3.4	4	2.5
Sigma threshold $\lambda$	1	1.5	1
Min size	9	9	9

## 3 Evaluation of staging and BG removal

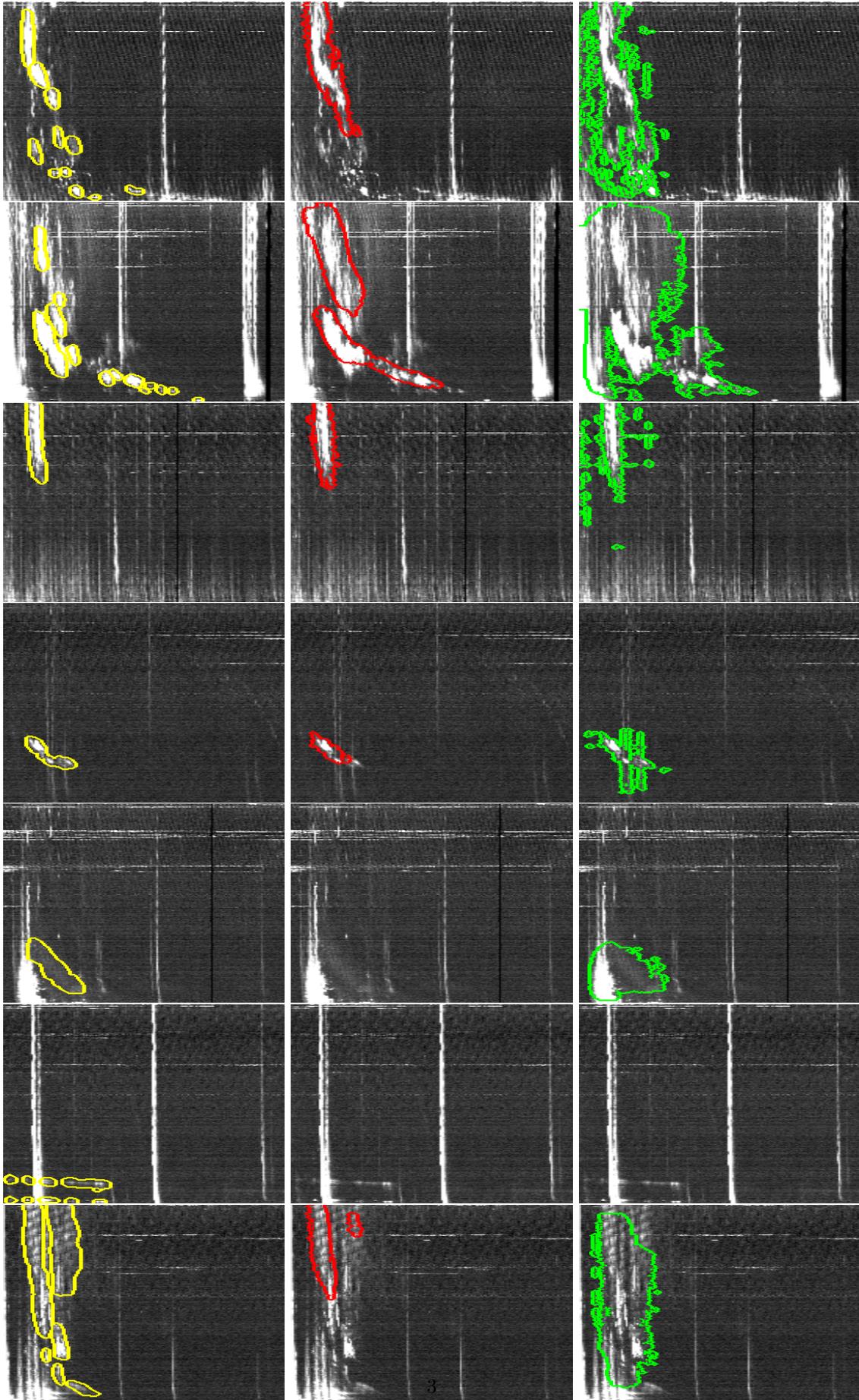
	Detection	No BG removal		BG removal	
		No staging	Staging	No staging	Staging
<b>Precision</b>	0.660	0.577	0.678	0.555	<b>0.694</b>
<b>Recall</b>	0.725	0.766	0.725	<b>0.787</b>	0.725
<b>F-score</b>	0.691	0.658	0.701	0.651	<b>0.709</b>
<b>IoU</b>	0.217	0.277	0.270	<b>0.292</b>	0.282

### 3.1 IoU surface



## 4 Random selection of automated detections

Col. 1 (yellow) manual; Col. 2 (red) adaptive ROI; Col. 3 (green) rect ROI



## 5 List of events and detections

- **Date format** — YYYY/MM/DD HH:MM
- **Detected=1** | Undetected=0

1997/04/01 14:00	1	2000/11/26 08:10	1	2004/06/03 16:48	1	2012/07/19 05:30	1
1997/04/07 14:30	0	2001/01/20 19:12	0	2004/06/04 07:50	1	2012/07/23 02:30	1
1997/05/12 05:15	1	2001/01/20 21:30	1	2004/06/22 22:07	1	2013/03/15 07:00	0
1997/09/23 21:53	1	2001/01/26 12:06	1	2004/07/23 19:00	1	2013/04/18 18:00	1
1997/11/03 05:15	1	2001/02/11 01:40	1	2004/08/08 09:15	0	2013/04/21 20:25	1
1997/11/03 10:30	1	2001/03/10 04:18	1	2004/10/24 03:12	1	2013/05/13 02:20	1
1997/11/04 06:00	1	2001/04/02 11:30	1	2004/11/07 16:25	1	2013/05/13 16:15	1
1997/11/06 12:20	1	2001/04/02 22:05	1	2004/11/09 17:35	1	2013/06/21 03:35	1
1997/11/27 13:30	0	2001/04/03 03:40	1	2004/12/08 20:05	1	2013/06/28 01:53	1
1997/12/12 22:45	0	2001/04/06 19:35	1	2004/12/29 16:35	1	2013/07/04 20:57	1
1998/03/29 03:05	1	2001/04/06 21:50	1	2004/12/30 23:45	1	2013/08/06 02:01	0
1998/04/23 06:00	1	2001/04/09 15:53	1	2005/01/04 11:20	0	2013/08/30 02:34	1
1998/04/27 09:20	1	2001/04/11 13:15	1	2005/01/15 06:15	1	2013/10/02 20:46	1
1998/05/02 14:15	0	2001/04/26 12:40	1	2005/01/20 07:15	0	2013/10/22 21:33	0
1998/05/02 17:00	0	2001/05/12 23:52	1	2005/05/02 22:40	0	2013/10/26 03:01	1
1998/05/06 08:25	0	2001/05/30 00:25	1	2005/05/03 00:20	0	2013/10/26 09:34	1
1998/05/09 03:35	0	2001/08/16 00:10	1	2005/06/03 12:50	1	2013/10/27 18:12	1
1998/05/11 21:40	1	2001/08/30 20:43	1	2005/06/16 20:25	0	2013/10/28 15:24	0
1998/05/19 10:00	1	2001/09/03 18:48	0	2005/07/09 22:15	0	2013/11/07 10:26	1
1998/06/16 18:20	1	2001/09/15 11:50	1	2005/08/01 14:15	0	2013/12/05 12:45	0
1998/11/02 14:00	1	2001/09/17 08:35	1	2005/08/22 01:30	1	2013/12/05 20:48	1
1998/11/06 03:00	1	2001/09/20 18:43	1	2005/08/23 15:00	0	2013/12/07 07:43	0
1998/11/07 00:20	1	2001/09/24 10:45	1	2005/08/29 11:10	0	2013/12/12 03:55	1
1998/11/08 11:20	1	2001/09/27 10:05	1	2005/08/31 11:40	0	2014/01/06 07:57	1
1998/12/18 17:50	1	2001/10/09 11:20	1	2005/09/03 03:20	1	2014/01/20 22:24	1
1999/04/24 13:50	1	2001/10/09 13:10	0	2006/08/16 15:45	1	2014/02/18 02:16	1
1999/05/03 05:50	1	2001/10/19 16:45	1	2006/08/26 20:40	0	2014/03/05 13:33	0
1999/06/04 07:05	1	2001/10/25 15:30	0	2006/11/06 10:35	1	2014/03/29 00:12	0
1999/06/11 11:45	1	2001/11/04 19:30	1	2006/12/06 19:00	0	2014/03/29 17:59	0
1999/06/23 05:50	1	2001/12/26 05:20	1	2007/01/25 06:55	1	2014/04/02 13:42	1
1999/06/29 19:20	0	2001/12/28 20:35	1	2007/12/31 01:05	1	2014/04/04 14:02	1
1999/09/03 03:00	0	2002/01/14 06:25	0	2008/03/25 19:05	0	2014/04/18 13:05	0
1999/10/14 09:10	0	2002/01/27 12:49	1	2010/08/01 09:20	0	2014/06/10 12:58	1
1999/10/17 23:27	1	2002/02/01 19:23	0	2010/08/18 06:05	1	2014/06/12 22:14	0
1999/11/16 05:17	1	2002/03/11 00:00	1	2011/01/13 09:15	1	2014/07/30 07:44	1
2000/02/12 03:55	1	2002/03/17 06:00	1	2011/01/27 12:20	1	2014/08/25 15:20	1
2000/02/17 20:42	1	2002/03/22 11:30	1	2011/02/13 17:50	1	2014/08/25 20:43	0
2000/03/02 13:50	1	2002/04/14 07:50	1	2011/02/15 02:10	0	2014/09/01 11:12	0
2000/04/04 15:45	0	2002/05/02 23:50	1	2011/03/07 14:30	1	2014/09/10 17:45	0
2000/04/18 15:00	1	2002/07/26 22:27	1	2011/05/29 21:10	0	2014/09/20 05:10	0
2000/05/05 16:35	1	2002/08/03 19:20	1	2011/06/02 08:00	1	2014/09/23 23:41	1
2000/05/07 21:15	0	2002/08/16 06:15	1	2011/06/02 12:00	1	2014/09/24 20:54	0
2000/05/12 23:34	1	2002/09/05 16:55	1	2011/06/04 07:00	0	2014/10/02 21:34	1
2000/05/15 16:47	1	2002/09/10 15:19	1	2011/08/02 06:15	1	2014/10/21 12:33	1
2000/06/02 22:00	0	2002/10/27 23:06	1	2011/08/04 04:15	1	2014/11/08 16:57	1
2000/06/06 15:20	1	2002/11/11 16:15	1	2011/08/09 08:20	0	2014/12/17 05:00	1
2000/06/06 18:45	1	2002/12/22 04:20	1	2011/09/22 11:05	1	2015/03/06 08:00	1
2000/06/10 17:15	1	2003/01/20 19:10	0	2011/09/25 05:30	1	2015/04/26 03:21	1
2000/06/15 19:52	1	2003/01/27 22:20	1	2011/10/21 13:15	0	2015/06/18 17:42	1
2000/07/22 11:45	1	2003/03/19 02:30	1	2011/11/09 13:30	1	2015/06/21 02:33	0
2000/08/11 11:35	0	2003/06/16 00:00	1	2011/12/25 18:45	1	2015/06/22 18:20	1
2000/09/12 12:00	1	2003/06/17 22:50	0	2012/01/02 15:00	0	2015/08/22 07:07	1
2000/09/19 08:45	1	2003/10/26 07:00	1	2012/01/19 15:00	1	2015/09/18 04:54	0
2000/10/05 22:10	1	2003/11/01 22:55	1	2012/01/27 18:30	1	2015/11/04 14:07	1
2000/10/25 09:30	0	2003/11/02 09:15	1	2012/03/09 04:10	0	2015/11/09 13:21	1
2000/11/03 18:35	0	2003/11/05 01:00	1	2012/03/26 23:15	0	2015/12/23 01:18	1
2000/11/08 23:20	1	2003/11/13 09:35	1	2012/03/27 21:45	1	2015/12/28 11:50	1
2000/11/09 01:15	1	2004/01/07 04:15	1	2012/04/09 12:20	1	2016/02/05 22:35	1
2000/11/09 16:15	1	2004/01/07 10:35	1	2012/04/15 02:30	1	2016/05/04 14:20	0
2000/11/23 08:16	1	2004/04/08 13:30	1	2012/07/04 17:00	1	2016/05/24 17:00	1
2000/11/24 15:25	0	2004/06/02 23:13	1	2012/07/17 14:40	1	2016/08/15 18:21	1