

# Inside AdaCore



*Spring/Summer 2016*

- ▶ GNATcoverage Extends Platform Support, Adds Features
- ▶ AdaCore Tech Days 2016
- ▶ Interview with Jamie Ayre
- ▶ QGen update
- ▶ Spotighting a GAP Member: Technical University of Munich (Germany)
- ▶ Public Ada Training in Boston and Paris
- ▶ AdaCore Sponsoring Ada Programming Competition

# GNATCoverage Extends Platform Support, Adds Features

GNATCoverage, AdaCore's non-intrusive tool for structural code coverage analysis, will see a number of significant enhancements in 2016. The tool is being offered on a variety of new native and cross platforms, with a number of new features.

For native applications, possibly requiring full Ada run-time semantics, GNATCoverage is now available for 32-bit Windows; it relies on the DynamoRIO dynamic monitoring framework to produce execution traces. The new Windows support complements GNATCoverage's existing native solutions on 32-bit and 64-bit Linux environments. Work to support 64-bit Windows applications is underway.

For cross configurations and unit-testing campaigns based on GNATemulator, GNATCoverage now handles a range of ARM targets. In addition to Leon, Leon3, PowerPC and E500v2, GNATCoverage provides off-the-shelf solutions for two standard boards equipped with ARM Cortex M4 and ARM Cortex R4 cores. Work is in progress on expanded support for integration testing campaigns when suitable probes can provide traces from execution on real hardware boards.

GNATCoverage is also adding several new features in upcoming releases. An improved coverage consolidation engine will let users combine intermediate coverage results instead of relying on raw execution traces, resulting in better performance and increased flexibility. Support for coverage analysis on code in dynamic libraries is also in progress, as is work

on controlling/preventing propagation of so called "incidental coverage" effects. (A unit's incidental coverage is the partial coverage it receives based not directly on the tests designed for that unit, but indirectly from tests of other code which happen to invoke the given unit).

Additionally, the GNATCoverage team is investigating how several Ada 2012 features affect compliance with coverage-related DO-178B/C objectives, and a paper on that topic was presented at the Embedded Real Time Software and Systems conference in January 2016. For example, expressions appearing in assertion-based contracts (such as pre- and postconditions) need to be taken into account, and likewise expressions in control expressions (if, case).

These enhancements and ongoing work preserve GNATCoverage's key characteristic: to allow precise assessments of object-level or DO-178B/C source-level coverage criteria up to MC/DC without instrumenting the application program. Instead, instrumented operating environments provide execution traces that the tool maps back to source constructs, based on debug information and Source Coverage Obligations (SCO) tables produced by the compiler. The non-intrusive nature of GNATCoverage simplifies the software certification effort, and the tool has been qualified as a verification tool for several airborne systems.

For further information please visit [www.adacore.com/gnatcoverage/](http://www.adacore.com/gnatcoverage/).

Entities	Coverage	Percentage
Explore	264 lines (11 not covered)	95 %
actors.adb	2 lines (0 not covered)	100 %
actors.ads	5 lines (0 not covered)	100 %
controls.ads	0 lines (0 not covered)	100 %
explore.adb	19 lines (0 not covered)	100 %
geomaps.adb	16 lines (0 not covered)	100 %
geomaps.ads	0 lines (0 not covered)	100 %
links.adb	21 lines (1 not covered)	95 %
links.ads	0 lines (0 not covered)	100 %
queues.adb	17 lines (2 not covered)	88 %
queues.ads	0 lines (0 not covered)	100 %
robots.adb	35 lines (2 not covered)	94 %
init	9 lines (0 not covered)	100 %
o		88 %
Robot_Control_Inport	1 line (0 not covered)	100 %
Robot_Situation_Outport	1 line (0 not covered)	100 %
Run	3 lines (0 not covered)	100 %
Unsafe	3 lines (0 not covered)	100 %
robots.ads	10 lines (0 not covered)	100 %
robots_devices-dummy.adb	59 lines (4 not covered)	93 %
robots_devices-dummy.ads	17 lines (0 not covered)	100 %
robots_devices.ads	10 lines (0 not covered)	100 %
stations.adb	45 lines (2 not covered)	95 %
stations.ads	8 lines (0 not covered)	100 %
overview.ads	undetermined	n/a
stacks.adb	undetermined	n/a
stacks.ads	undetermined	n/a
Base	n/a	n/a
Common	n/a	n/a
Libsupport	n/a	n/a

```
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
1000
```

GNATCoverage Output Example





AdaCore

# TECH DAYS BOSTON & PARIS

AdaCore is hosting two customer-oriented events this year, providing an opportunity to learn more about our products, meet other AdaCore users, and for the Boston event to get hands-on training from the company's technical experts. Register now for the Paris or Boston events.

**BOSTON, MA SEP 21-22, 2016**

**PARIS, FRANCE OCT 6, 2016**

[www.adacore.com/techdays](http://www.adacore.com/techdays)

# Jamie Ayre

## Commercial Team Lead



▶ **Jamie, tell us about your background and how you came to be involved with Ada and AdaCore. What is your current role?**

I did my undergraduate work at Sheffield Hallam University in the UK where I concentrated in International Business. As part of these studies I spent a semester at the ESSEC Business School in France. I enjoyed that experience and also the venue, so I subsequently moved

to Paris. After a couple of marketing positions in other companies I joined AdaCore in 2003. Based in the Paris office I was very attracted to AdaCore's multinational nature and the exciting prospects that such a small company, with a prestigious customer list, could offer me. As AdaCore has grown globally, so has my role within it. I now have the position of Commercial Team Lead which encompasses both marketing and sales responsibilities.

▶ **AdaCore's software product line is geared to technically sophisticated users. In formulating a marketing strategy for such a customer base, what kinds of challenges have you encountered and how have you addressed them?**

When I first joined the company I had very little knowledge of software development and the technologies used to build robust applications. When I visited our website or read our product literature, I probably understood less than 10% of it! Clearly we were doing something right though, as we already had a very impressive customer list. Understanding the value we provided would be essential in order to effectively market our products. This was made possible through interaction with customers and some very patient and clever colleagues.

A number of points became clear to me. First, Ada is an excellent language for building software that matters, but for various reasons it has occupied a fairly narrow niche. Second, AdaCore's expertise and support made us a leader in this niche and increasingly more respected in the broader software development community. Third, we have a privileged relationship with our customers because first and foremost we are an engineering company with an exceptionally strong technical staff. For these reasons,

AdaCore has adopted a strategy of promoting Ada in a number of application areas, especially those that are requiring more and more reliability in their software. We have also taken the "no marketing hype" approach with our publicity material, and hence it consists of solid technical content. Finally, we are fortunate to have a large technical staff who participate in our marketing as content creators; it's always better to have engineers "talk" to engineers. A good example of this was the "Gems" program—a series of technical tutorial-style articles on parts of our technology that might not otherwise get much publicity. Each gem article was written by an engineer with expertise in the subject, often one of the product developers. So my role has mostly involved managing the marketing effort and making sure that deadlines were met.

This approach has shown some really nice results. Over the last few years we have seen our customer and prospect numbers grow not only in our traditional aerospace markets but also in new ones such as automotive and rail. Interest in Ada has grown in the general developer community, and this pushed us to create [u.adacore.com](http://u.adacore.com) which provides online Ada and SPARK courses and labs for newcomers. It's great to see that the embedded world is moving more and more to answers that Ada can provide!

▶ **One of the trends in recent years has been rapid growth of social media. How has this influenced AdaCore's marketing and sales activities?**

For marketing purposes, social media allow us to engage in conversations with focused communities in a less formal, more personal manner. It is very much about having quality discussions and if you hit the right topic, you can quickly escalate the number of views on a blog post or article. Once again, we encourage our engineering staff to engage in these peer-to-peer forums that are the lifeblood of many communities. Through such interactions we've been achieving our main marketing goals and reaching an audience of "digital natives" for whom the traditional publicity channels might not be so effective.

▶ **Any hobbies or outside interests that you'd like to share?**

I love to travel, socialize and meet new people from different cultures. Fortunately my job allows me to do this, as I spend a large part of my time in the US and at various conferences. To disconnect from the world of forecasts and targets I also like to "game" and I'm currently fighting (not so successfully) through Dark Souls III. Fortunately, even in this domain, I have a number of colleagues I can rely on for help and advice!

---

## QGen Adds New Features

AdaCore's QGen model-based development toolset continues to grow. One of its newest capabilities is support for Processor-In-the-Loop (PIL) simulation: users can take the code that QGen generates from a Simulink®/Stateflow® model and execute it on both emulated and hardware targets. Models can thus be tested in realistic environments, directly from the Matlab® console. Another new feature, now available for beta testing, is the QGen model-level debugger. It supports a synchronized view of the model and the corresponding source code while debugging, along with the ability to set block-level breakpoints in auto-generated code and to display and set signal values when stopped at such breakpoints. Recent usage of QGen in industrial settings confirms that it can generate efficient code for very large models and also support development using multiple versions of the Simulink® environment, from R2008a through R2016a. Several new videos are available on the AdaCore website demonstrating QGen's various capabilities. For additional information please visit [www.adacore.com/qgen](http://www.adacore.com/qgen).



## Spotlighting a GAP Member

# Technical University of Munich (Germany)

### A weather balloon that comes back to its takeoff location

The Real-Time Computer Systems group at the Technical University of Munich is developing a light-weight weather balloon that climbs up to the stratosphere, logs data such as pressure, wind, and temperature, and subsequently performs a controlled descent back to the takeoff location. The operators can thus conveniently retrieve the payload of high-rate sensor data and save the equipment for later reuse. Since ordinary weather balloons can drift away hundreds of kilometers and might never be located, the homing function is a major advantage. The core of the system is a fixed-wing glider configuration that needs to be stabilized and guided home by an on-board autopilot, without external control.

Mr. Martin Becker, a PhD candidate in the Real-Time Computer Systems group, is Project Director, and much of the work is being done in the context of graduate theses. Since the University is a member of AdaCore's GNAT Academic Program (GAP), the group has chosen the latest Ada/SPARK environment to develop and verify the autopilot software. "We had some experience verifying C programs, where we learned that a large portion of the software defects stemmed from weaknesses in the language," said Mr. Becker. "By choosing SPARK together with the Ravenscar run-time, we get the strict semantics that we need, the ability to use well-structured concurrency features, and the formal underpinning to identify defects by analysis. This gives us high confidence in the software's correctness while also saving testing and debugging effort; there's no need to extensively test all the possible failure scenarios and simulate the environmental conditions."

The glider weighs less than 1kg and will have to cope with wind speeds above 100km/hour and temperatures below -40°C. Fitting the necessary electronics brings the system close to its power and weight limits. Thus there is no room for redundancy, and failures need to be avoided by construction as far as possible.

"We know, before running the program the first time, that we will not have run-time errors, and this allows us to invest more time addressing the challenges with the airframe and sensors," added Mr. Becker. "Additionally, the software is being designed to detect and mitigate hardware failures as far as possible, so our verification efforts will also include proving the high-level behavior for specific failure cases."

As part of this project the group is porting the ARM Cortex M4 STM32F4 bareboard run-time with the Ravenscar Small Footprint profile to the Pixhawk flight controller, and rewriting those parts in SPARK where formal verification is most useful. The launch of the weather balloon is expected later this year.

To find out more about this project please contact Martin Becker at [becker@rcs.ei.tum.de](mailto:becker@rcs.ei.tum.de), and for information about GAP please visit [www.adacore.com/academia/](http://www.adacore.com/academia/).

## Ada training

### Ada Programming with GNAT: Fundamentals

AdaCore is holding public Ada courses in its Paris and Boston (Lexington) offices during the week of November 14–18. Combining live lectures and hands-on workshops using the latest GNAT toolsuite, these courses will cover major features of the Ada language and explain important points of software engineering style. Attendees will learn Ada essentials such as the datatype system, exceptions, packages / encapsulation, separate compilation, and generics. The courses will focus on Ada 95 and will also cover recently added features such as Ada 2012's contract-based programming support. No previous experience with Ada or the GNAT tools is required.

For a detailed outline and pricing/registration information please visit [www.adacore.com/training/](http://www.adacore.com/training/).

## AdaCore Sponsoring Ada Programming Competition

### Enter the "Make with Ada" competition for a chance to win 5000 euros!

To help promote the use of Ada, AdaCore is sponsoring a competition to design and implement an embedded software project where Ada and/or SPARK are the principal language technologies. This "Make with Ada" competition will award five prizes, based on the criteria of software dependability, openness, collaborativeness, and inventiveness. For example, entrants will need to demonstrate that their system meets its requirements and has been developed using sound software engineering practices. The top prize is 5000 euros.

By encouraging the use of Ada and SPARK, the competition aims to help the embedded software community improve the quality of their code. It is open to individuals and to teams of up to four people; participants should have a new idea for an embedded system and a desire to realize that idea using Ada or SPARK. For more information please visit [www.makewithada.org/](http://www.makewithada.org/).

## newsflash

### Ada UK launched

The Ada UK technical society has been chartered to promote the Ada language in the UK as a means of improving software quality. The new group, a successor to its namesake society that was active around Ada 83, will be a member organization of Ada-Europe and will represent the interests of the growing number of Ada users in the UK in aerospace and other industries. For further information please contact Dene Brown at [denebbrown@gmail.com](mailto:denebbrown@gmail.com).

### HIS 2016 conference presents best practices

This year's High Integrity Software conference will be held in Bristol UK on November 1. Featuring experts from industry and academia, HIS 2016 will highlight best practice across a variety of safety- and security-critical domains. Dino Distefano (Facebook) and Duncan Brown (Rolls Royce) will be keynote speakers. To see the full program and to register, please visit [his-2016.co.uk](http://his-2016.co.uk).

## CodePeer officially registered as CWE-Compatible

The MITRE Corporation has awarded AdaCore's CodePeer advanced static analysis tool the formal designation of "CWE-Compatible" in their Common Weakness Enumeration (CWE) Compatibility and Effectiveness Program, a web-based initiative that consolidates and organizes information about cyber security products and services. CodePeer can detect several of the Top 25 Most Dangerous Software Errors in the CWE: CWE-120 (Classic Buffer Overflow), CWE-131 (Incorrect Calculation of Buffer Size), and CWE-190 (Integer Overflow or Wraparound). For details please visit [cwe.mitre.org/compatible/program.html](http://cwe.mitre.org/compatible/program.html) and [cwe.mitre.org/compatible/organizations.html](http://cwe.mitre.org/compatible/organizations.html).

## ProofInUse joint lab with Inria helps enhance SPARK toolset

The ProofInUse cooperative project between AdaCore and French research institute Inria has completed its second year, successfully achieving several milestones in connection with its underlying goal of solving hard problems in formal verification technology. The overall usability of the SPARK environment has been enhanced with the ability to generate counterexamples when an automatic proof fails, and the Why3 engine can now automatically prove bitwise and modulo operations. These results were being presented at a NASA Formal Methods symposium in June and at a Software Engineering and Formal Methods conference in July (see the calendar highlights section of this newsletter). Work is continuing on the proof of floating-point properties and on interactive proof. For more information please visit [www.spark-2014.org/prooifinuse/](http://www.spark-2014.org/prooifinuse/).

## EN 50128 booklet available

A booklet is available explaining how AdaCore's technologies can help developers meet the requirements of the CENELEC EN 50128:2011 safety standard on software for railway control and protection systems. Authored by CERTIFIER safety assessor Jean-Louis Boulanger and AdaCore's Quentin Ochem, this booklet summarizes the EN 50128 standard and describes how the Ada and SPARK languages together with AdaCore tools and run-time libraries can be used to develop software up to the highest safety integrity level. For a free copy of this booklet please contact [info@adacore.com](mailto:info@adacore.com); a pdf version is available on line at [adacore.com/en-50128/](http://adacore.com/en-50128/).

## HILT 2016 workshop focusing on model-based development

ACM's Special Interest Group on Ada (SIGAda) will be holding an open workshop on Model-Based Development and Contract-Based Programming during October 6 and 7 in Pittsburgh, as the latest in its series of High Integrity Language Technology (HILT) conferences and events. HILT 2016 will be part of the Embedded Systems Week activities and will feature Prof. Philip Koopman (Carnegie-Mellon University) and John Knight (University of Virginia) as keynote speakers. The HILT workshop will provide a forum for researchers and practitioners to discuss tool and language technologies that offer a formal approach to model-based development. For further information including a link to a registration page please visit [www.sigada.org/conf/hilt2016/](http://www.sigada.org/conf/hilt2016/).

## calendar highlights / July–November 2016

For up-to-date information on conferences where AdaCore is participating, please visit [www.adacore.com/events/](http://www.adacore.com/events/).

### SEFM 2016: International Conference on Software Engineering and Formal Methods July 4–8, 2016 / Vienna, Austria

David Hauzar is presenting a paper "Counterexamples from Proof Failures in SPARK".  
[staf2016.conf.tuwien.ac.at/sefm/](http://staf2016.conf.tuwien.ac.at/sefm/)

### GNU Cauldron September 9–11, 2016 / Hebden Bridge, UK

AdaCore is a major sponsor and exhibitor.  
[gcc.gnu.org/wiki/cauldron2016](http://gcc.gnu.org/wiki/cauldron2016)

### AdaCore Tech Days 2016—US September 21–22, 2016 / Burlington MA, USA

AdaCore is holding its annual customer-focused Tech Days event.  
[www.adacore.com/techdays/](http://www.adacore.com/techdays/)

### DASC 2016: 35th Digital Avionics Systems Conference September 25–29, 2016 / Sacramento CA, USA

AdaCore is a sponsor / exhibitor at this event.  
[2016.dasconline.org/](http://2016.dasconline.org/)

### ACM SIGAda High Integrity Language Technology (HILT) Workshop 2016 October 6–7, 2016 / Pittsburgh PA, USA

Tucker Taft is workshop co-chair, and AdaCore is a sponsor of this event.  
[www.sigada.org/conf/hilt2016/](http://www.sigada.org/conf/hilt2016/)

### AdaCore Tech Day 2016—Europe Oct 6, 2016 / Paris, France

AdaCore is holding its annual customer-focused Tech Days event.  
[www.adacore.com/techdays/](http://www.adacore.com/techdays/)

### ARM TechCon October 25–27, 2016 / Santa Clara CA, USA

AdaCore is exhibiting at this event.  
[www.armtechcon.com](http://www.armtechcon.com)

### High Integrity Software (HIS) 2016 November 1, 2016 / Bristol, UK

AdaCore is a major sponsor and an exhibitor.  
[his-2016.co.uk](http://his-2016.co.uk)

### Public Ada Training November 14–18, 2016 / Lexington MA, USA and Paris, France

AdaCore is conducting an Ada Fundamentals course at its Boston-area and Paris offices.  
[www.adacore.com/training](http://www.adacore.com/training)

### Embedded Software Engineering (ESE) Kongress November 28–December 2, 2016 Sindelfingen, Germany

AdaCore is exhibiting at this event.  
[www.ese-kongress.de/english/](http://www.ese-kongress.de/english/)

*Inside AdaCore* is published twice a year simultaneously in New York and Paris by AdaCore.

150 W. 30th Street, 16th floor  
New York, NY 10001, USA  
tel +1 212 620 7300  
fax +1 212 807 0162

46 rue d'Amsterdam  
75009 Paris, France  
tel +33 1 49 70 67 16  
fax +33 1 49 70 05 52

[info@adacore.com](mailto:info@adacore.com)  
[www.adacore.com](http://www.adacore.com)

**AdaCore**

© Copyright 2016 AdaCore. All rights reserved.  
All trademarks are the property of their respective owners.