

# Duncan G. Cumming, Ph.D. (Camb.)



## Expertise

- ITC Experience
- Power Supplies
- Electronic Hardware
- Embedded Control Systems
- GPS Systems
- Joystick Design (Games)
- RF Systems

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## Professional Summary

Dr. Duncan G. Cumming, Ph.D. (EE, Cambridge University, England, 1979) is the president of Emmanuel Avionics, Inc at San Pedro, California. He has been in the business of electronic design since 1979. Dr. Cummings' core business is the design of electronic controls for the Unmanned Air Vehicle (UAV) market, including inertial measurement, autopilots, electrical power controls, RF systems and video technology. These technologies are mostly applicable to the civilian market, although some UAVs do have military applications. Dr. Cumming has a wide scientific background, and is able to provide expert testimony and assess both the performance and the newness of various technologies. While this is primarily useful in Intellectual Property disputes, it has occasional applications in other types of cases.

## Employment History

- |           |   |  |
|-----------|---|--|
| From:     | 1996  | <b>Emmanuel Avionics, Inc.</b>           |
| To:       | Present   | San Pedro, CA                            |
| Position: | <i>President – Electronic hardware consulting.</i>  |  |
| From:     | 1984  | <b>Cambridge Electronic Design, Inc.</b> |
| To:       | 1996  | San Pedro, CA                            |
| Position: | <i>Chief Executive Officer – Electronic hardware consulting.</i>                            |  |
| From:     | 1982  | <b>Unified Technologies, Inc.</b>        |
| To:       | 1984  | Los Angeles, CA                          |
| Position: | <i>Senior Systems Design Engineer. Designed video game software and CRT display system.</i> |  |

From: 1979 **Hughes Aircraft Co.**  
To: 1982 Los Angeles, CA  
Position: *Member of Technical Staff – commissioned electron beam microfabrication system*

From: 1979 **Cambridge University Engineering Dept.**  
To: 1979 Cambridge, UK  
Position: *Postgraduate Research Student – Researched revolutionary new e-beam imaging system.*

## Consulting History

Dr. Cumming has a wide range of expertise acquired over the years. Clients have included everything from one man operations to Fortune 500 companies. Some of the major clients are shown below:-

From: 1984 **Client:- Aero Vironment, Inc.**  
To: Present Simi Valley, CA  
Duties: Design and construction of numerous electronics packages for unmanned air vehicles.  
**Embedded Control Systems** including Atmel and Motorola. Experienced using Integrated Development Environments.  
**Switched Mode Power Supplies.** Over the years, Dr Cumming has worked on a wide variety of switched mode power supplies. From computer card supplies (5V) to high voltage (30kV), and some exotic supplies with input voltages of less than a volt. He has used most supply topologies at one time or another, for boost mode, buck mode and both.  
**RF Systems** including receiver design, video transmitter design, digital control systems and radio modems.  
**Transducers** including **accelerometers**, integrated gyros, conventional rate **gyros**, pressure transducers, **strain gauges** and **magnetometers**.  
**Inertial Measurement Units (IMU).** Both design from scratch, and utilization of commercially available units.  
**Unmanned Air Vehicle Design**, including both fixed wing and rotary types, on all scales from 6 inch wing span to 270 feet.

From: 1983 **Client:- Hughes Aircraft Co**  
To: 1984 Torrance, CA  
Duties: Enhancement and maintenance of electron beam microfabrication system.  
**Magnetic Deflection Systems.** High resolution deflection systems for electron beam microfabrication, raster mode and vector mode deflection systems for cathode ray tubes, and one combined system that did both raster and vector deflection simultaneously.

From: 2009      **Client:- Sage Cheshire, Inc**  
To: 2010      Lancaster, CA  
Duties: Design and construction of space suit chest pack for Red Bull Stratos high altitude parachuting record attempt.  
**Global Positioning System.** Selection and interfacing of suitable GPS receivers for a large variety of tasks, including supersonic speed measurement using civilian GPS receivers.

From: 1986      **Client:- Applied Research Associates, Inc.**  
To: 1989      Albuquerque, NM  
Duties: Design and construction of numerous electronics packages for 70 foot unmanned surveillance blimp.  
**Video Camera** control systems. Pan/tilt units, gyro stabilized camera mounts.  
**Autopilots.** Dr Cumming has designed autopilot systems for fixed wing, rotary, blimp, and balloon systems.  
**Infra Red,** Visible Light, and Low Light video camera systems.

From: 1984      **Client:- Other**  
To: Present  
Duties: Electronic Hardware Design Projects  
**RF design** for underground pipe detection, metal detection, and other low frequency (VLF) applications.  
**Joystick Design** and human factors engineering, including force operated joysticks, programmable joysticks, and “use in the air” joysticks (i.e. not connected to any fixed object).  
**Pneumatic Control Systems.** Automatic braking and throttle control systems. Investigation of “sudden acceleration” problems.  
**Autonomous Vehicle Design.** Dr. Cumming developed the interface units for a vehicle that entered the DARPA Grand Challenge, a government sponsored unmanned ground vehicle competition.  
**Rocket Payload Systems.** Both sub-orbital and near-space systems.  
**Power Electronics.** Dr Cumming has designed 400Hz harmonic reduction systems for the Boeing 747 aircraft, high power oscillators (1MHz, 10kW), motor control systems, and heater control systems.  
**Magnetic Levitation Systems.** Dr Cumming has designed everything from a simple overhead solenoid system to a complete levitation system operating entirely from below a flat table top, with no visible sensors.  
**High Voltage Pulsed Systems.** Dr Cumming has worked with a 10kV, 3Amp, 50nS pulsed system for field emission cathodes.  
**High voltage DC systems.** Dr Cumming has worked with a number of high voltage control systems in the electron beam microfabrication industry, up to 30kV. He is also familiar with the use of **thermionic tubes** in such control systems, one of the few surviving uses of the thermionic tube today.

**Vacuum Systems.** Dr Cumming has experience with both diffusion pumped high vacuum systems and ultra high vacuum ion pumped systems. He has worked with tungsten, LaB<sub>6</sub>, and field emission cathodes and the associated high voltage equipment.

## Litigation Support Experience

Date: 1996  
 Case Cambridge Electronic Design, Inc.  
 Project: Testified as the defendant in a contractual dispute with Cambridge Electronic Design, Inc. This involved a successful petition to compel arbitration in superior court, and testimony (using telephone conference calls) for the ensuing binding arbitration.  
 Status: Case closed, no damages awarded.

Date: 2010  
 Matter International Trade Commission Action  
 Project: Acted as a Consulting Expert Witness in a patent validity case involving power supplies.  
 Status: My involvement complete, but case ongoing as of Oct, 2010

Date: 2011  
 Matter International Trade Commission Action  
 Project: Acted as a Testifying Expert Witness in a patent validity case involving marine autopilots.  
 Status: Case settled on favorable terms following my testimony at deposition.

Date: 2012  
 Case Product Liability Case – Superior Court Of The State Of California  
 Project: Acted as a Testifying Expert Witness against a luxury automobile manufacturer in a product liability case involving an automotive braking system.  
 Status: Jury verdict against the auto manufacturer in March, 2012.

Date: 2012  
 Matter International Trade Commission Action  
 Project: Acted as a Testifying Expert Witness in a patent validity case involving hand held computers.  
 Status: Case dropped prior to first deposition.

## Patents

<u>Patent Number</u>	<u>Date Issued</u>	<u>Title</u>
7013.001	May 24, 1996	Cordless Free Floating Joystick (Provisional)

## Education

<u>Year</u>	<u>College/University</u>	<u>Degree</u>
1979	Cambridge University, England	Ph.D., Electrical Engineering

1978	Cambridge University, England	MA
1974	Cambridge University, England	BA

## **Publications**

Cumming, A.D.G. "A Method For Determining The Geometry Of Field Emitters" *Optik*, **49** No.1 (1977) 17-23.

Bishop, J.F., Cumming, A.D.G., Ferrari, R.L., Miller K.J. "Cambridge University Vatnajokull Expedition, 1977" *Polar Record*, **19** No. 118 (1978) 51-57.

Cumming, A.D.G., Smith, K.C.A. "Energy Spread And Fluctuations In Field Emitted Electron Beams" *Microcircuit Engineering* ed. H. Ahmed, W.C. Nixon © Cambridge University Press (1980) 575-579

Cumming, A.D.G. "A High Speed, Noise Tolerant Edge Detection Algorithm Using A Low Bandwidth Signal Chain for E-Beam Registration" *Microcircuit Engineering* (Feb 1981)

Cumming, A.D.G. "A High Performance, Low Cost, Isolated Electron Current Amplifier" *Scanning* © G. Witzstrock Publishing House Inc., 2, (1979) 104-109

## **Professional Associations and Achievements**

- Member, IEEE
- Fellow of Cambridge Philosophical Society