Bruce Schena | Electromechanical Product Design

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web-based resume & portfolio | **www.silicontraption.com**

Elevator Pitch

I am an engineer, inventor, and entrepreneur with 20+ years of professional experience in and around technology, machines, robots, and computers. I possess the "engineer gene" and have known that designing and building contraptions would be central to my life from a very early age. I am presently a senior member of the engineering staff at Intuitive Surgical, focused on architecting & engineering a new generation of surgical robots (real robots, real people, real surgery). I have a full machine shop in my garage and have 48 issued US Patents, with another 20-30 pending.

Professional Experience

Feb 2006 -Present
Engineering Fellow
Intuitive Surgical (NASDAQ: ISRG)
One of two "Engineering Fellows" (the most senior engineering position attainable) in the company. Team leader focused on designing *next-next*-generation robotic surgery systems. 12 patent applications filed in the last 18 months.
Sunnyvale, California

2002-Present (on hiatus)
Electromechanical Consultant
Silicontraption
Freelance electromechanical product design. Clients include early stage startups as well as established publicly-traded medical equipment companies. Projects include consumer products, mobile handset (cell), microcontroller-enabled architectural products, and surgical robots.
Menlo Park, California

1995-2002
Co-Founder, Chief Technical Officer, Board Member, VP Engineering, Director of R&D, IPO Team Member, Corporate Spokesperson, Corporate Secretary, Electrical Engineer, Machinist, Modelmaker, Electrical Technician, Staff Therapist :-)
Immersion Corporation (NASDAQ: IMMR)
Helped grow company from 3 full-time employees to a publicly-traded company employing 180+ people and $20+ Million in annual sales. Individual contributor and engineering team leader on key product development efforts for both Immersion-brand and licensed strategic partners such as BMW, Logitech, and Kensington.
San Jose, California

1993-1995
Electromechanical Consultant
Pandemonium Product Development
Freelance electromechanical product design. Clients included Golfpro International, Surgical Robotics (Kleiman Medical), Nomadic Technologies, and Immersion Corporation
Menlo Park, California

1992-1995
Teaching Assistant
Stanford University, Product Realization Lab
Taught all aspects of manufacturing technology including conventional & CNC machining, foundry, welding, woodworking, and modelmaking. Often responsible for safety of 30 overstressed, sleep-deprived students in a machine shop environment.
Stanford, California

1992
Product Design (internship & part-time)
IDEO Product Development
Electromechanical design for client projects including General Motors, Canon, Arneson Pool Products, and Coinstar. Responsible engineer for original pre-production inductive charge-port mechanism for GM *Impact* electric vehicle.
Palo Alto, California

(continued next page)

1989-1991 **Mechanical Engineer & Project Manager**
Odetics Incorporated, Advanced Intelligent Machines Division
Lead development of state-of-the art, light-weight, high-strength, dexterous robotic arm. Joint project with NASA Jet Propulsion Laboratory. Arm was featured on the cover of NASA Tech Briefs magazine and won the Grand Prize in a national engineering design competition and was featured in Design News Magazine.
Anaheim, California

1987-1989 **Mechanical Engineer**
Odetics Incorporated, Advanced Intelligent Machines Division
Engineer and project leader for all manner of robotic contraptions – robotic hands, arms, legs, beer-tank-cleaning robots during the heyday of Odetics robotics programs.
Anaheim, California

1986-1987 **Research Assistant**
MIT Laboratory for Construction Automation
Professor Alex Slocum
Massachusetts Institute of Technology
Graduate work focused on design of a robotic concrete-block-wall building robot.
Cambridge, Massachusetts

1982-1986 **Research Assistant**
MIT Space Systems Lab (now at University of Maryland)
Professor David Akin
Massachusetts Institute of Technology
Team member focused on robotic arms, hands, cameras, cranes, thrusters, contactors, water tanks, batteries, circuit boards, computers, CAD, and everything else imaginable. I also had the privilege to participate in the construction of a milestone Space Shuttle experiment called EASE which flew on STS-61B in 1985, two flights before Challenger.
Cambridge, Massachusetts

Skills

Technical

- Mechanical design & engineering
- Electronic design & engineering
- High, medium, & low-volume product design processes
- High, medium, & low-volume product manufacturing processes
- High, medium, & low-volume production line start-up, vendor qualification, IQC start-up
- Comprehensive knowledge of state-of-the-art sensing, actuation (motor), and power amplifier technologies
- Fluent with software, firmware, servo control, robot control, optoelectronics, and metrology
- Highly experienced in sourcing key components, materials, and vendors (domestic, Europe, Asia)
- Highly experienced in advanced R&D (products, core technologies)
- Design of medical/surgical products for FDA & UL compliance
- Design of high volume consumer products for FCC/CE compliance
- Technical project & team management
- Patent development, prosecution, & defense
- Skilled machinist (conventional & CNC), woodworker, welder, rapid prototyping, modelmaking
- Industrial design/product aesthetics
- Applications & Tools

CAD	Solidworks ('97Beta thru 2004), AutoCAD (R2.7 through R14), Ashlar Vellum, HP ME10/30 (circa 1993), Pro-E (circa 1989), Aries ConceptStation (circa 1987), CADAM (circa 1982)
CAM	CamWorks, Surfcam, Virtual Gibbs, MasterCAM, native G-code
FEA (statics, dynamics, thermal)	CosmosWorks, Cosmos/M, Working Model, NASTRAN 4D (some), Algor
FEA (magnetostatics)	Magneto (2D), Amperes (3D), CosmosEMS (3D), Spead (voicecoils)
Electrical Engineering	Orcad, Electronics Workbench Pro
Programming Languages	Visual Basic, VBA, C, Forth, Motorola 68HC11 assembly, Basic, Fortran
Technical/Analytical	Matlab, MathCAD, Photoworks
Productivity	All common desktop applications & utilities

Strategic

- Corporate-level technology strategy (products & core technologies)
- "Inbound" technology partnerships (actuators, sensors, ASIC design, foundry services, independent inventors)
- Experienced in managing R&D-to-Product transitions
- Sponsored (Federally-funded) research strategy, proposals, & execution (e.g. SBIR, STTR, NIST ATP)
- Strategic management of extensive corporate intellectual property (IP) portfolio

Business

- Member of Board of Directors (Public & Private)
- Chief Technical Officer (Public & Private)
- Executive-level (VP) corporate governance
- Entrepreneurship – strategy, finance, fundraising, business plan
- Experience with "Product", "IP licensing", and "Fabless Semiconductor" business models
- Initial Public Offering – S1 preparation, review, sign-off, roadshow participant
- Public relations – top-tier press interviews & relationship development – sole Corporate Spokesperson responsibility
- Analyst relations – top-tier market analyst relationship development
- Legal (inbound) – partnership agreements, pricing agreements, cooperative development agreements
- Legal (outbound) – tactical management of extensive intellectual property (IP) portfolio
- Project proposals & presentations
- Investment bank/private investor relations
- Engineering, R&D Group Management
- Corporate acquisition integration

Education

Stanford University

DEGREE OF ENGINEER (D.Eng.) 1995
Stanford, California
Focus: Joint Program in Design (Product Design)
Dissertation: ***Design of a Global Network of Interactive, Force-Feedback Sculpture***
GPA 4.0/4.0

Joint Program in Design (Product Design). This exclusive (12-15 students per year) world-renowned program emphasizes a broad, hands-on, multidisciplinary approach to design spanning the School of Engineering, Graduate School of Business, and Department of Fine Art. The Program aspires to train students to develop innovative products (where "product" spans the largest possible definition) that are sensitive to human needs while maintaining acute awareness of highly intertwined technical, business, and aesthetic concerns.

My focus in the Program included "smart" (microprocessor-based) product design, computer-integrated sculpture, industrial design, and business. Normally a Master's Degree level program, I was the first (and possibly still only) person to graduate with the advanced Degree of Engineer in Product Design.

The D.Eng. degree itself is also very unique in that it lives between Masters and PhD degrees (closer to the PhD) and encourages highly customized coursework and independent investigation. Like the PhD program, the D.Eng. degree requires a written dissertation. My dissertation was entitled ***Design of a Global Network of Interactive, Force-Feedback Sculpture***; focusing simultaneously on the aesthetic and human interaction implications of remote-yet-intimate physical interaction (haptics) and the telecommunications architecture, bandwidths, and latencies required to make it work.

While at Stanford, I held Teaching Assistant positions with Professor Mark Cutkosky (undergraduate coursework development), Professor Rolf Faste (classroom TA for ME115A), and Professor David Beach ("Shop TA" in the Product Realization Lab (PRL) for 2½ years). In the last 2 years I also worked full time as an independent product design consultant in order to support my own thesis work as it fell far outside "normal boundaries" for sponsored work.

Massachusetts Institute of Technology

MASTER OF SCIENCE, Mechanical Engineering, 1987
Cambridge, Massachusetts
Focus: mechanical design, precision machine design, robotics, metrology, control theory
Thesis: ***Design Methodology for Large Work Volume Robotic Manipulators: Theory and Application***
GPA: 5.0/5.0

As a student of Professor Alex Slocum, I gained a deep appreciation and enhanced design skills in the areas of precision machine design (micron, sub-micron tolerances), metrology, and automation. Our lab was focused on developing new ways to apply automation techniques and technologies to building construction. Applying these "non-traditional" technologies to this challenging, dynamic environment often required us to invent and apply new solutions in areas such as large-scale metrology, mobility, lightweight/high strength actuation, advanced control, and robust mechanical design. My thesis was entitled ***Design Methodology for Large Work Volume Robotic Manipulators: Theory and Application.***

Massachusetts Institute of Technology

BACHELOR OF SCIENCE, Mechanical Engineering, 1986
Cambridge, Massachusetts
Focus: mechanical design, robotics/teleoperation, control theory
Thesis: ***Design and Construction of an Interchangeable End Effector Interface for a Space Teleoperator Manipulator Arm***
GPA: 4.7/5.0, Pi Tau Sigma, Tau Beta Pi honor societies

I hooked up with the MIT Space Systems Lab before classes had started my freshman year. I spent 4 perfectly awesome years working under Professor David Akin (who has since moved the SSL operation to University of Maryland) building the most amazing and exciting robots and machines in all of MIT. I also had the great fortune to be taken underwing by a graduate student Eric Shain who launched me down the path of robots, teleoperation, and design of computer-controlled electromechanical devices in general. Almost daily, I was able to apply newfound engineering theory to design problems in the lab. I worked on robotic arms, hands, cameras, cranes, thrusters, contactors, water tanks, batteries, circuit boards, computers, CAD, and everything else imaginable during my tenure there. I also had the privilege to participate in the construction of a milestone Space Shuttle experiment called EASE which flew on STS-61B in 1985, two flights before Challenger.

Publications

Design of a Global Network of Interactive, Force-Feedback Sculpture, D.Eng. dissertation, Stanford University, 1995

Art & Technology: Paths, Intersections, Artifacts, invited paper for *Virtually There – The Impact of Interactive Media on the Arts in the Twentieth Centur*y, Catherine Smith Gallery, Appalachian State University, Boone, NC, July 1995

A Lightweight, High Strength, Dexterous Manipulator for Commercial Applications, Co-authored with N. Marzwell and S. Cohan, NASA Technology 2001 Conference, San Jose, CA December 3-5, 1991

Design and Development of a Compact, Modular, 7-Axis Manipulator Arm, Co-authored with S. Cohan, American Nuclear Society Winter Meeting, San Francisco, CA, November 10-13, 1991

Design of a Reconfigurable, Adaptive Shape Hand, Third Topical Meeting on Robotics and Remote Systems, Charleston, SC, March 13-16, 1989

Design Methodology for Large Work Volume Robotic Manipulators: Theory and Application, Master of Science thesis, MIT, 1987

Blockbot: A robot to Automate the Construction of Concrete-Block Walls, Co-authored with Professor A. Slocum, Robotics, Fall 1987

Construction Automation Research at MIT, contributing author, Fourth International Symposium on Robotics and Artificial Intelligence in Building Construction, Haifa, Israel, June 1987

Design and Construction of an Interchangeable End Effector Interface for a Space Teleoperator Manipulator Arm, Bachelor of Science Thesis, MIT 1986

Theoretical Analysis of the Parachute Bridling System Under Static Loading, SEAS final report to the U.S. Forest Service, Foster-Miller, 1986

Awards and Press Coverage

Awards – Personal/Design Team

Industrial Designers Society of America (IDSA) & Business Week, Bronze Award, Medical & Scientific Products 2006, **daVinci-S Surgical System**
The Chicago Athenaeum Museum of Architecture and Design, Good Design 1999, ***Logitech Wingman Joystick***
ID Magazine *42nd Annual Design Review 1996, Design Distinction Award* - ***Immersion MicroScribe-3D***
Design News Magazine, *Excellence in Design 1992, Grand Prize* - ***Odetics Dexterous Manipulator***
NEA Competition – Finalist for Design Arts Grant Award, *Kinesthetic Constructions*, 1995
Wunsch Foundation Award for Excellence in Design, Bachelors thesis work, MIT 1986

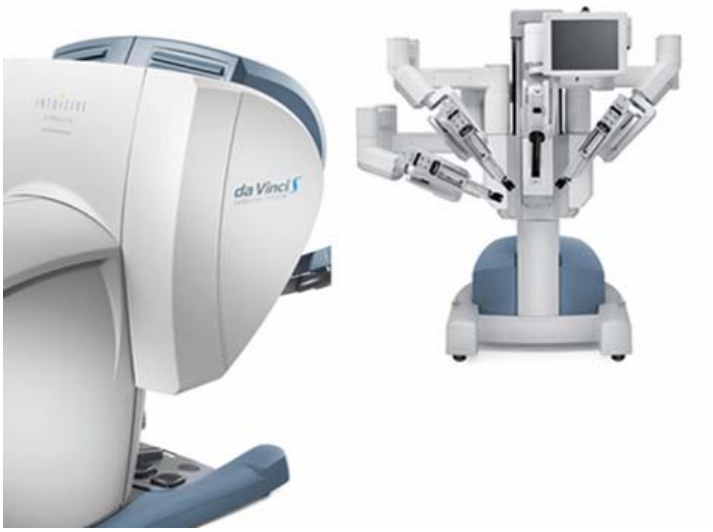
Awards – Corporate

Silicon Valley Business Journal – *100 Fastest Growing Private Companies in Silicon Valley* 1998 (Immersion placed #19 of 100)

Press Coverage based on 1-on-1 personal meetings with reporters & industry analysts

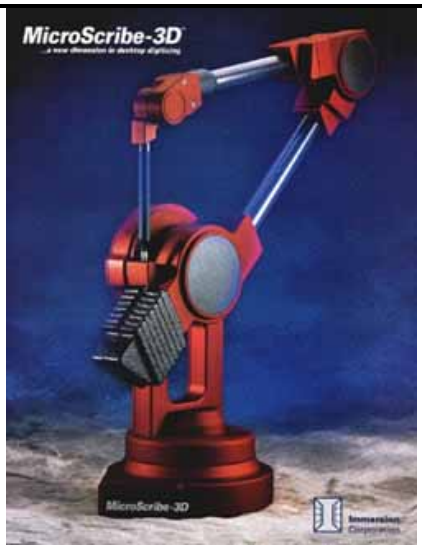
New York Times
ABC World News Tonight w/Peter Jennings
Forbes
Technology Review (MIT)
Bloomberg
FamilyPC Magazine
Seattle Post-Intelligencer
EE Times
TechTV (Bay Area)
Wall Street Journal
USA Today
Wired
Discover Magazine
PC Week
ZDNet
Oakland Tribune
Mechanical Engineering
Associated Press
Newsweek
Business 2.0
Scientific American
CNet
LA Times
CanalPlus (France)
KRON TV (Bay Area)

Brief Visual Design Portfolio

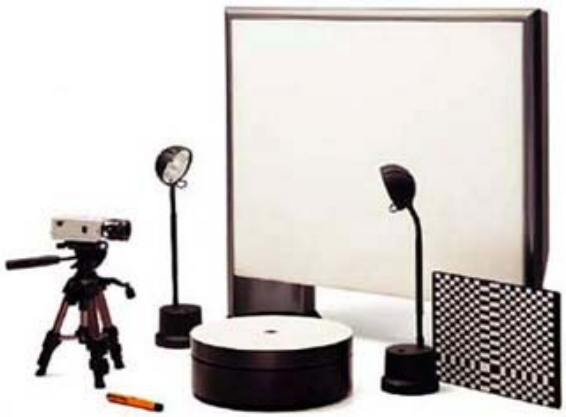


daVinci-S Robotic Surgical System

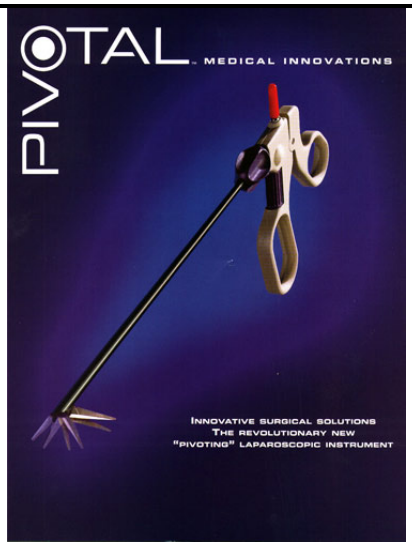
Odetics Dexterous Manipulator



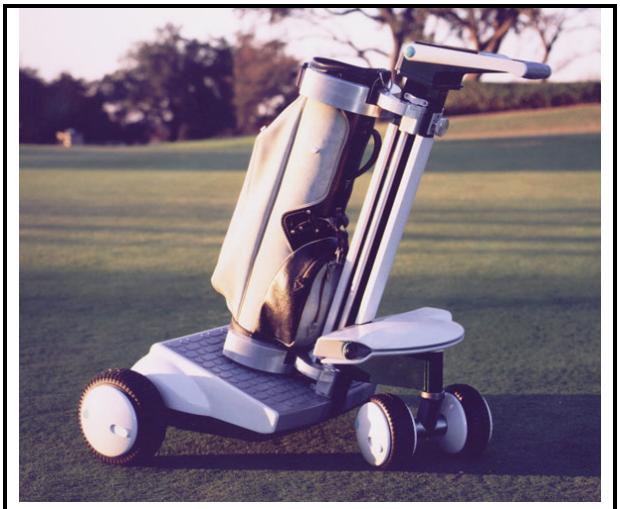
MicroScribe 3-D Digitizing Arm



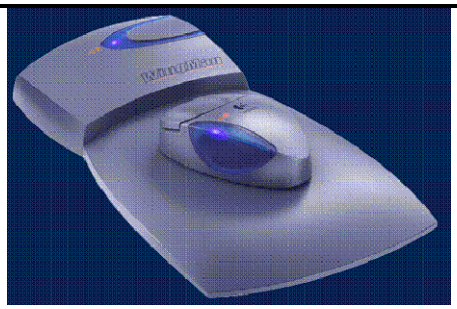
LightScribe Digitizing System



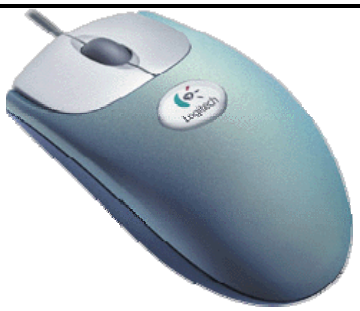
5mm Articulated Laparoscopic Instrument
for Pivotal Medical Innovations



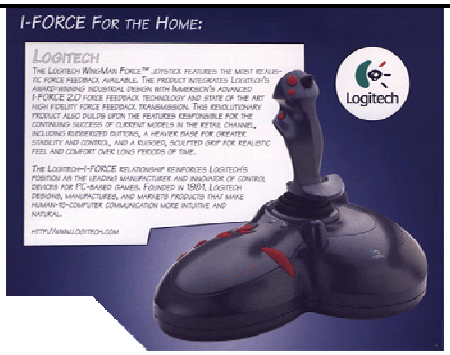
GolfPro Intelecady
Robotic Golf Caddy



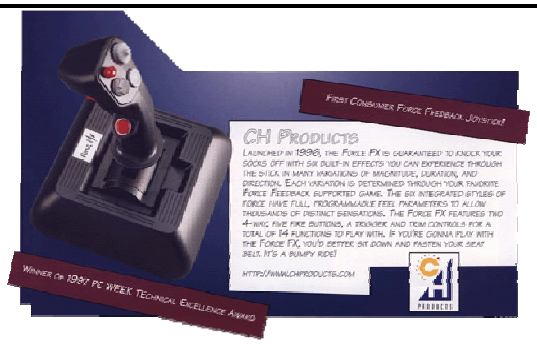
Logitech Wingman
Force Feedback Mouse



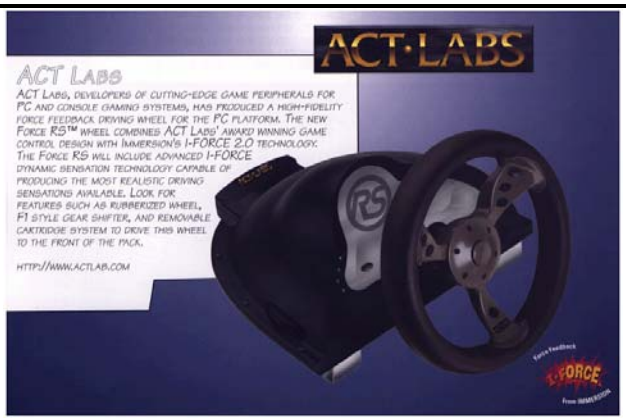
Logitech I-Feel Mouse



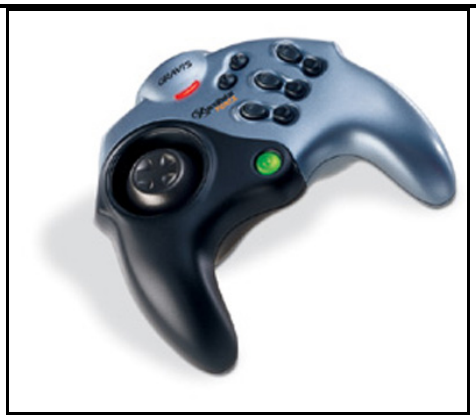
Logitech Force Feedback Joystick for PC



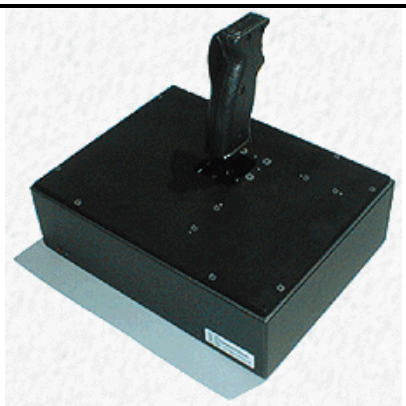
CH Products *Force FX* PC Joystick



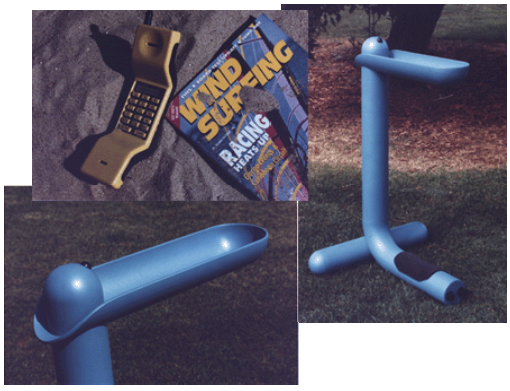
ACT Labs Force RS
Racing Wheel for PC



Gravis Exterminator
Force Feedback Gamepad



Indestructible Force-Feedback Joystick
for DisneyQuest



Various Industrial Design
Explorations

Issued Patents (United States only)

Note: List does not include an additional 20-30 pending (US), plus another 80-100 (wild guess) international versions issued & pending

	Patent Number	Title
1	7,113,166	Force feedback devices using fluid braking
2	7,106,313	Force feedback interface device with force functionality button
3	7,084,854	Actuator for providing tactile sensations and device for directional tactile sensations
4	7,061,466	Force feedback device including single-phase, fixed-coil actuators
5	7,054,775	Digitizing system and rotary table for determining 3-D geometry of an object
6	7,038,657	Power management for interface devices applying forces
7	6,956,558	Rotary force feedback wheels for remote control devices
8	6,937,033	Position sensor with resistive element
9	6,903,721	Method and apparatus for compensating for position slip in interface devices
10	6,822,635	Haptic interface for laptop computers and other portable devices
11	6,762,745	Actuator control providing linear and continuous force output
12	6,704,001	Force feedback device including actuator with moving magnet
13	6,697,748	Digitizing system and rotary table for determining 3-D geometry of an object
14	6,697,048	Computer interface apparatus including linkage having flex
15	6,693,622	Vibrotactile haptic feedback devices
16	6,686,911	Control knob with control modes and force feedback
17	6,486,872	Method and apparatus for providing passive fluid force feedback
18	6,400,352	Mechanical and force transmission for force feedback devices
19	6,348,911	Force feedback device including safety switch and force magnitude ramping
20	6,342,880	Force feedback system including multiple force processors
21	6,304,091	Absolute position sensing by phase shift detection using a variable capacitor
22	6,271,833	Low cost force feedback peripheral with button activated feel sensations
23	6,271,828	Force feedback interface devices providing resistance forces using a fluid
24	6,201,533	Method and apparatus for applying force in force feedback devices using friction
25	6,191,774	Mouse interface for providing force feedback
26	6,166,723	Mouse interface device providing force feedback
27	6,154,201	Control knob with multiple degrees of freedom and force feedback
28	6,134,506	Method and apparatus for tracking the position and orientation of a stylus and for digitizing a 3-D object
29	6,128,006	Force feedback mouse wheel and other control wheels
30	6,125,337	Probe apparatus and method for tracking the position and orientation of a stylus and controlling a cursor
31	6,100,874	Force feedback mouse interface
32	6,078,876	Method and apparatus for tracking the position and orientation of a stylus and for digitizing a 3-D object
33	6,050,718	Method and apparatus for providing high bandwidth force feedback with improved actuator feel
34	6,020,875	High fidelity mechanical transmission system and interface device
35	6,015,473	Method for producing a precision 3-D measuring apparatus
36	5,999,168	Haptic accelerator for force feedback computer peripherals
37	5,929,846	Force feedback interface device including grounded sensor system
38	5,929,607	Low cost force feedback interface with efficient power sourcing
39	5,907,487	Force feedback device with safety feature
40	5,817,119	Surgical instrument for endoscopic and general surgery
41	5,805,140	High bandwidth force feedback interface using voice coils and flexures
42	5,792,165	Endoscopic instrument with detachable end effector
43	5,724,264	Method and apparatus for tracking the position and orientation of a stylus and for digitizing a 3-D object
44	5,721,566	Method and apparatus for providing damping force feedback
45	D389,782	Robotic golf bag carrying cart
46	5,691,898	Safe and low cost computer peripherals with force feedback for consumer applications
47	D377,932	Mechanical digitizing arm used to input three dimensional data into a computer
48	5,582,617	Surgical instrument for endoscopic and general surgery

Garage Machine Shop (well…part of it at least)