UNIVERSITY of WASHINGTON
COLLEGE OF ENGINEERING

CCAM MAJOR FACILITIES

MANUFACTURING

Digital manufacturing:

Stratasys Objet 260 Connex 3D Printer: Materials: up to 14 photopolymers. Build envelope: 255 × 252 × 200 mm, Layer thickness: 16-micron.

Stratasys Fortus 400mc 3D Printer: Materials: ABS plastic, Polycarbonate, ULTEM 9085, and PPSF/PPSU. Build envelope: 406 x 355 x 406. Layer thickness: 254-micron, X-Y accuracy of ± 127 micron.

Stratasys Dimension BST768 3D Printer: Materials: ABS. Build envelope: 203 × 203 × 305 mm. Layer thickness: 254-micron, X-Y accuracy of ± 127 micron

Mcor Matrix 3D Printer: Materials: eco-friendly office paper and water-based adhesive. Build envelope: 256mm x 169mm x 150mm. Layer thickness: 100-micron, X-Y accuracy of ± 100 micron.

ZCorp 310+ 3D Printer: Materials: ABS plastic, Polycarbonate, elastomers, high performance composites. Build envelope: 203 x 254 x 203 mm. Layer thickness: 89-203 micron.

ZCorp 400 3D Printer: Materials: ABS plastic, Polycarbonate, elastomers, high performance composites. Build envelope: 203 x 254 x 203 mm. Layer thickness: 76-203 micron.

ExOne/Prometal R1/RD1 3D Printer: Materials: metals, stainless steel, bronze. Build envelope: 50.8 x 38.1 x 50.8 mm. Layer thickness: 50 - 200 micron.

(pending MRI NSF funding)
Nanoscribe 3D laser lithography system: Technology: maskless two-photon polymerization (780nm wavelength), Materials: photopolymerizable resins, Build area: 100 x 100 mm^2. Out-of-plane resolution: 1 µm, in-plane resolution: 150 nm. (the only instrument of its kind in the Pacific Northwest region)

Preparation and processing:

Autoclave (American Autoclave) (3): 400°F, 100psi, 3’ dia. x 8’ long and 2’ dia. x 3’ long. 3 vacuum ports.

Wabash G50H-24 Heated-Platen Press: Capacity: 50 ton. Heated platen size: 609 x 609 mm, Temp: up to 650° F.

Blue-M lab ovens (2): Temperature range: ambient to 480°F, dimensions: L x D x H = 20”x20”x20”, and 35”x30”x48”.

Autometrix Advantage CNC Fabric Cutter: Max fabric dimensions: 62" x 94".

MultiCam 7000 CNC Router: Materials cut: foam molds and plugs, and carbon fiber pre-preg and fabric patterns. Table dimensions: 60" x 102".

Abrasive Waterjet system WJP1313 Cutting area 4'3"x 4'3"x 8" (1.3 x 1.3 x .2 M).

Abrasive Waterjet system (Flow Int.): Pressure: 60 ksi, cutting area: 48"x48".

Electrical Discharge CNC Machine (Hansvedt): Table size: 9" x 14.1", Surface finish: 8µinch AA.

HAAS CNC Mill (TM-1P): Travel: (x-y-z) 30"x12"x16, Table size: 47.74"x10.5"x5/8", Spindle max speed: 6000 rpm.

MATERIAL CHARACTERIZATION

Mechanical testing

Instron electro-mechanical test frames for quasi-static tests, Capacities: 22 up to 56 kip. Accessories: Bluehill v2 control and data acquisition software, Pneumatic grips, tensile wedge grips, compression platens, 3&4-point bend fixtures, Laser extensometer, clip-on extensometers (axial and transverse), IITIR compression fixture (ASTM D3410), Iosipescu shear test fixture (ASTM D5379), Laminate Bearing Strength Fixture (ASTM D5961), Boeing Open-Hole Compression Fixture (ASTM D6484). Vishay System 5000 signal conditioning and data acquisition systems; 20 channels for strain gauges, thermocouples, and ±10V analog signals.

Instron servo-hydraulic test frames for cyclic fatigue tests, Capacity: 5 up to 22 kip.

Thermotron environmental chamber Temp range: -100°F to +350°F, L x D x H = 16"x11"x12".

Instron Rotating Beam Fatigue Testing System: Frequency: up to 600000 cycles per hour. Bending moment capacity: 20in-lb to 200 in-lb.

Instron Dynatup 9250HV drop tower: Capacity: 830 Joule, 65 ft/sec. Instrumented tup, 3500 lbf capacity. ISO-6603-2 test fixture. Integrated environmental chamber, -60°F to +350°F.

Instron CAEST 9350 droptower: Energy range: 0.59-1800J, Impact Velocity: 0.77 - 24 m/s, Drop weight: 2-70Kg. Impactor: 16 mm diameter (hemispherical), Environmental chamber: -70°C to +150°C. Anti-rebound system.

VIC-3D Digital Image Correlation Systems (Correlated Solutions): various 3D DIC systems composed of high speed cameras (up to 82,000 frames/sec), strain resolution: 0.005% microstrain or better, strain range: 0.005%-2000%.

Laser Doppler vibrometer: Polytec OFV 534, OFV-5000 with DD-900 and VD-09.

Microscopy

Optical microscopes with digital cameras and image processing; 5X to 1,000X magnification.

FEI Scanning Electron Microscopes (SEM). Resolutions: up to 3 nm. Accelerating voltages up to 30kV.

Atomic Force Microscopes: x-y scan range: 90µm x 90µm, z scan range: 10µm z-sensor noise level: up to 35pm RMS.

Rheological, thermal, chemical analysis

VERTEX 70 FTIR spectrometer (Bruker): spectrum: 6000 cm^{-1} to 80 cm^{-1}.

Netzsch Differential Scanning Calorimetry (DSC): Temp range: -274 to 1110° F, Enthalpy precision ±0.05% - 0.2%.

Netzsch Thermogravimetric analyzer (TGA): Temp range: room temp up to 1110° F, Resolution: 1µg.

Bruker D8 Focus X-Ray Diffractometer (XRD): NaI scintillator type detector with low background (0.4 cps) and high dynamic range (up to 2×106).

Netzsch Dynamical Mechanical Analyzer (DMA): Force range: 12N (static), 12 N (dynamic), Temp range: -274 to 1110° F, frequency range: 0.01 to 100 Hz.

STRUCTURAL CHARACTERIZATION

Mechanical testing

Baldwin servo-controlled universal testing machine: Capacity: up to 2400kip (axial)

MTS 809 Axial/Torsional servo-hydraulic machine: Capacity: up to 110kip (axial), up to 50000 lb-in (torsional).

VIC-3D Digital Image Correlation Systems (Correlated Solutions): various 3D DIC systems composed of high speed cameras (up to 82,000 frames/sec) and 3D digital acquisition system, strain resolution: 0.005% microstrain or better, strain range: 0.005%-2000%.
Olympus OMNISCAN SX Ultrasonic Testing Machine: Connectors: 1 Phased Array connector: Olympus PA connector 2 UT connectors. Pulse width: from 30ns to 500 ns. System bandwidth: 0.6 MHZ to 18 MHZ.

(Under installation. Expected availability: March 2016)
North Star Imaging X5000 Industrial 2D Digital X-ray and 3D Computed Tomography (CT) System: Nominal part envelope: 32’ (dia.) x 48’ tall**,** Overall system resolution: 500nm or better. X-ray energy: 10-450 kV. Geometric magnification: 2000x.
(This system offers a unique resolution even for structural components)

UW Related Faculty (alphabetical)

Nicholas Boechler	**ME**	boechler@uw.edu | 206-221-6515 Research areas: Mechanics of materials, photoacoustics, nonlinear dynamics, phononic crystals and metamaterials, dynamics of micro/nanostructures
Brian Flinn	**MSE**	bflinn@uw.edu | (206) 616-9068 Research areas: Experimental Mechanics of Materials - Fracture and Fatigue, Structure-Processing-Property Relationships of Advanced Materials, Engineering Education-Knowledge Retention and Transfer from Course to Course, Joining of Composites and Advanced Materials
Mark Ganter	**ME**	ganter@uw.edu | (206) 543-5090 Research areas: 3D volume (voxel) space representations, object segmentation (including biological), wavelets representations of volume data. Development of new materials and processes for 3D printing and 3D printing systems (including ceramic printing materials).
Ramulu Mamidala	**ME**	ramulum@u.washington.edu | (206) 543-5349 Research areas: Mechanics of Materials, Fracture Mechanics & Fatigue, Surface Treatment & Surface Integrity, Machining & Drilling Science of Composite Materials, Friction Stir Welding
Marco Salviato	**A&A**	salviato@aa.washington.edu | (206) 543-2170 Research areas: Mechanical behavior of materials and structures at multiple scales, development of computational and analytical tools
Duane Storti	**ME**	storti@u.washington.edu | 206-543-5090 Research areas: 3D printing and novel approaches to geometric design, new materials systems for 3D printing, solid modeling specifically suited for compatibility with 3D image stacks
Mark Tuttle	**ME**	tuttle@uw.edu | 206-685-8047 Research areas: Applied solid mechanics, composite materials and structures, adhesion mechanics, and viscoelasticity
Anthony Waas	**A&A**	awaas@aa.washington.edu | (206) 221-2569 Research areas: Composite structures, Structural stability, Biologically inspired Materials, Nanocomposites, Engineered materials
Jinkyu Yang	**A&A**	jkyang@aa.washington.edu | (206) 543-6612 Research areas: Mechanics and dynamics of structures, Design of engineered material systems, Nondestructive evaluation and structural health monitoring

Aerospace Forum Faculty Lead:
Anthony M. Waas, Boeing-Egtvedt Chair, Professor of Aerostructures
William E. Boeing Department of Aeronautics & Astronautics
awaas@aa.washington.edu or (206) 221-2569