

ADVANCED MULTI-PHYSICS ANALYSIS

AS A COMSOL CERTIFIED CONSULTANT, CONTINUUM BLUE OFFERS ADVANCED MULTI-PHYSICS ANALYSIS SERVICES TO CLIENTS DEVELOPING PRODUCTS WHERE COUPLED PHYSICAL PHENOMENA PLAY A STRONG ROLE IN THE DESIGN & OPTIMIZATION OF THE PRODUCT.

COUPLED PHYSICAL PHENOMENA CAN INCLUDE:

- STRUCTURAL (STRESS-STRAIN / DEFORMATION / FATIGUE)
- FLUID DYNAMICS (MICRO-FLUIDICS / PARTICLE FLOW)
- HEAT TRANSFER (THERMAL)
- ELECTRICAL (AC / DC)
- CHEMICAL REACTIONS
- ACOUSTICS
- ELECTROMAGNETIC RADIATION (RADIO WAVES / MICROWAVES / LASERS)
- MICRO-ELECTROMECHANICAL SYSTEMS (MEMS)
- FLUID-STRUCTURE INTERACTION (FSI)

FROM CLIENTS THAT INCLUDE BAE SYSTEMS, GE & B.BRAUN & ANALYSIS PROJECTS THAT SPAN FROM THE LASER HEAT TREATMENT & FORMATION OF METAL ALLOY STRUCTURES

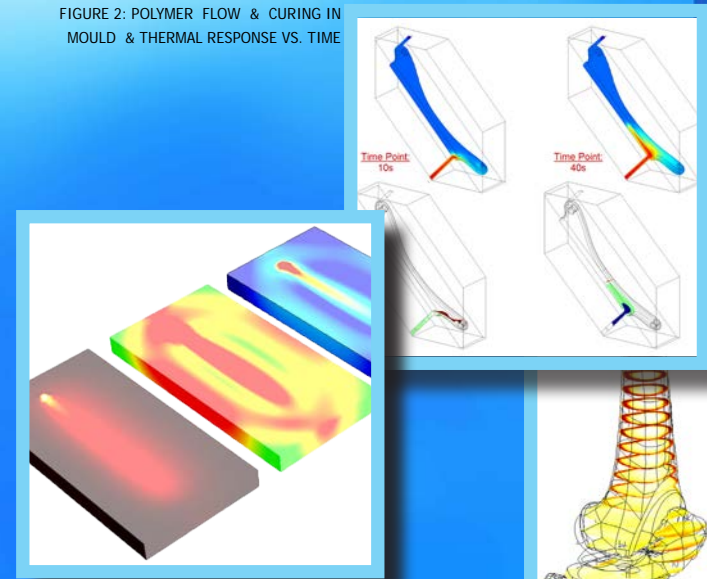


FIGURE 1: LASER HEAT TREATMENT & RESIDUAL STRESS OF METAL ALLOY STRUCTURE (TIME-DEPENDENT STUDY)

& THE MONITORING OF THE RESULTING RESIDUAL STRESSES WHICH CAUSE PERMANENT DEFORMATION TO THESE STRUCTURES (FIGURES 1), TO THE SIMULTANEOUS MOULDING OF POLYMERS, WITH FLUID FLOW, THERMAL & CHEMICAL INTERACTIONS (MULTIPLE POLYMER CURING & FREE SURFACE FLOWS) (FIGURES 2), THROUGH TO THE LONG-TERM BONE REMODELLING OF ORTHOPEDIC IMPLANTS SUCH AS ACETABULAR CUPS & FEMORAL STEMS (FIGURES 3 & 8), CONTINUUM BLUE HAS THE EXPERIENCE & EXPERTISE TO CATER FOR ALL YOUR ANALYSIS NEEDS.

WITH ADVANCED MULTI-PHYSICS ANALYSIS WE CAN HELP ASSESS YOUR PRODUCT DESIGN PRIOR TO PROTOTYPING & PRODUCTION. REDUCING PRODUCT DEVELOPMENT CYCLES, COST & ELIMINATING REDUNDANT DESIGNS AT AN EARLY STAGE. WITH FINITE ELEMENT ANALYSIS (FEA) METHODS & COMPUTATIONAL TECHNIQUES, WE CAN PROVIDE THESE SERVICES TO YOU. ANALYSIS STUDIES CAN INCLUDE:

- STEADY STATE (STATIC)
- DYNAMIC (TIME DEPENDENT / DYNAMIC / DROP TESTS)
- MODAL (HARMONICS / NATURAL FREQUENCIES)

COMPLIMENTARY TO OUR MULTI-PHYSICS ANALYSIS SERVICES, CONTINUUM BLUE ALSO PROVIDES THE FOLLOWING SERVICES:

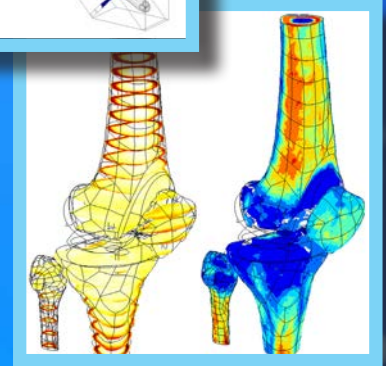


FIGURE 3: BONE MATERIAL PROPERTIES (KNEE)

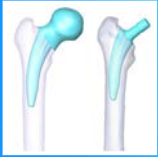


MATERIAL SELECTION : ASSESSMENT & OPTIMIZATION (FIGURES 4-7)

KINEMATIC SIMULATIONS : FORCE & RESPONSE CURVES

DESIGN OPTIMIZATION : RESPONSE VS. PROPERTIES, COST & WEIGHT

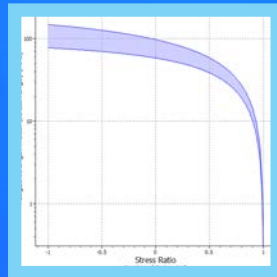
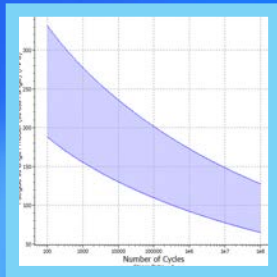
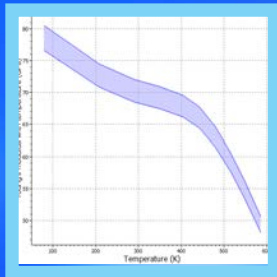
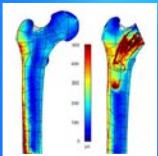
TESTING : MATERIALS, STRESS-STRAIN RESPONSE & CHARACTERIZATION



ADVANCED MATERIAL MODELLING & CHARACTERISATION

WITH OVER 20 YEARS OF MATERIALS EXPERIENCE & OVER 24,000 CHARACTERIZED MATERIALS, CONTINUUM BLUE HAS AN EXTENSIVE DATABASE WHICH IS READILY MADE AVAILABLE TO CLIENTS. THE DATABASE INCLUDES DETAILED PROPERTIES & DEPENDENT RELATIONSHIPS WITH TEMPERATURE & OTHER PARAMETERS SUCH AS STRAIN RATE. WE HAVE THE CAPABILITY TO ASSESS & IMPLEMENT ADVANCED MATERIAL & FLUID MODELS, INCLUDING:

- NEWTONIAN & NON-NEWTONIAN FLUIDS
- DUCTILE MATERIALS (PLASTICITY)
- RUBBER-LIKE MATERIALS (HYPER-ELASTIC)
- ANISOTROPIC & ORTHOTROPIC MATERIALS (COMPOSITES / WOVEN / BRAIDED)
- BIOLOGICAL MATERIALS (BONE / SOFT TISSUES / IMPLANTABLE FABRICS)
- FATIGUE PROPERTIES & S-N CURVES (FRETTING & MATERIAL FATIGUE CURVES (FIGURES 5 & 6))



FIGURES 4, 5 & 6 STRESS vs. TEMPERATURE, S-N CURVE & FATIGUE STRESS vs. STRESS RATIO OF COPPER ALLOY

FIGURE 7: MATERIAL FRACTURE TOUGHNESS vs. TEMPERATURE FOR MATERIAL SELECTION & OPTIMIZATION

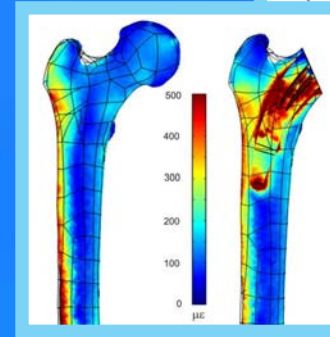
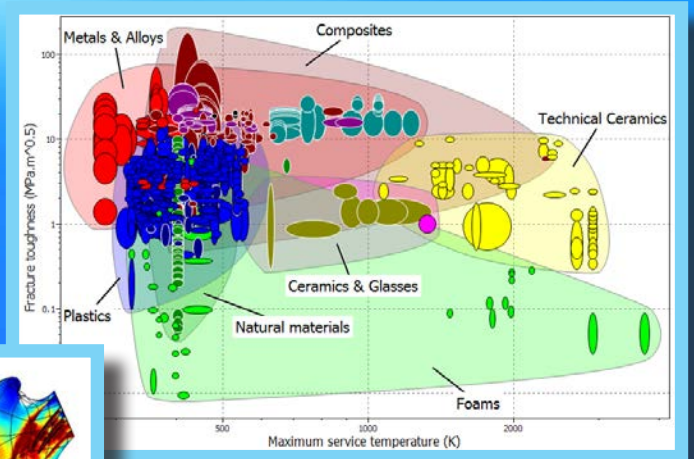


FIGURE 8: BONE REMODELLING IN FEMORAL STEM IMPLANT

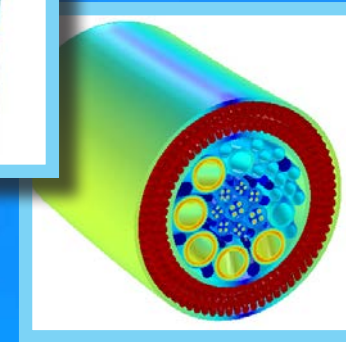
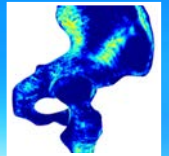
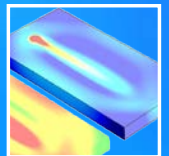
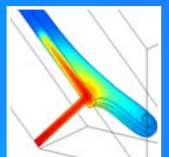


FIGURE 9: SUBSEA CABLE / UMBILICAL STRESS & FATIGUE ANALYSIS



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