

Univerzitet u Novom Sadu
FAKULTET TEHNIČKIH NAUKA
MSS PROIZVODNO MAŠINSTVO
Merni sistemi, RE i CAQ

CAD-INSPEKCIJA

Uvodne napomene

Razvoj i primena CAD-modela u inženjerskim oblastima implicirala je razvoj ideja za iskorišćavanjem najpre određenih parametara, a zatim i ukupnih modela i za potrebe kontrole/verifikacije/inspekcije.

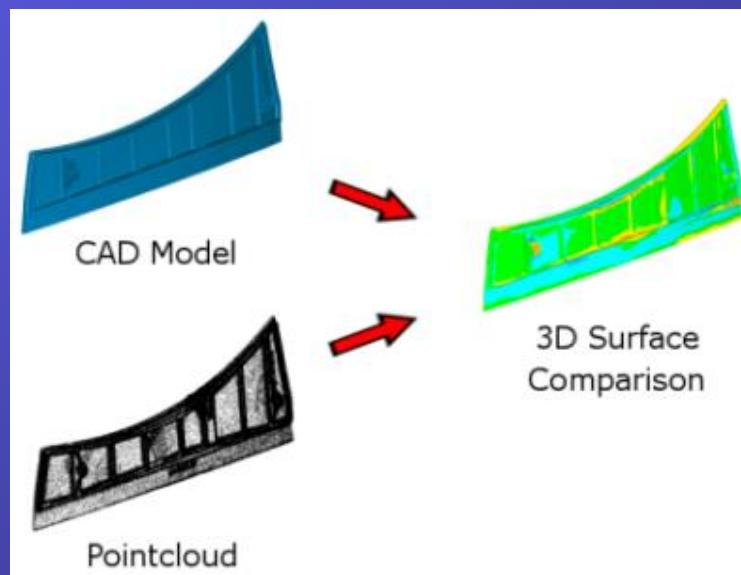
- Preduslov za dobar inženjerski proces jeste sprovođenje kontrole/verifikacije tokom njegovog odvijanja.
- Savremeni pristupi kontrole su danas deo procesa **računarom podržana inspekcija (computer-aided inspection CAI)**.
- Jedan od vidova **CAI podrazumeva komparaciju (poređenje) oblaka tačaka u odnosu na CAD (površinski/solid) model.**
- Rezultat analize tj. odgovor na pitanje: “Koliko oblak tačaka odstupa od CAD modela?” je **mapa u boji ili kolor mapa kod koje svaka boja predstavlja određeni nivo odstupanja.**
- Ova metoda je prihvaćena kao brz, efikasan i kredibilan način provere kvaliteta izrade delova različitim tehnologijama (3D štampa, rezanje, plastično deformisanje, oblikovanje plastike itd.)

Računarom podržana inspekcija

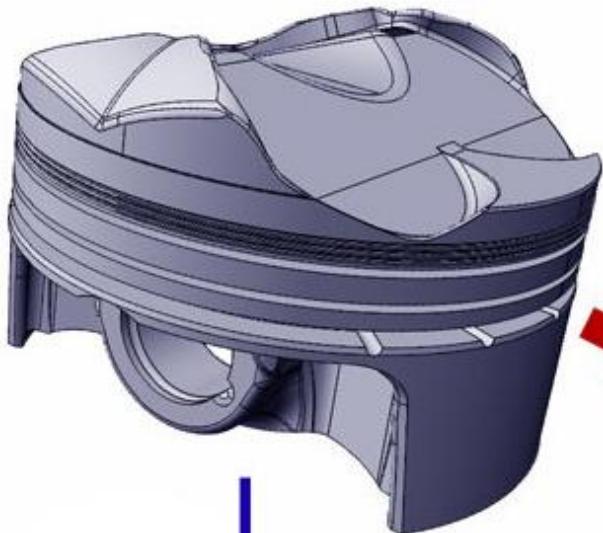
Računarom podržana inspekcija (Computer-Aided Inspection CAI)

predstavlja metodu koja poređi geometriju proizvedenog dela (rezultat 3D digitalizacije) u odnosu na referentnu geometriju (originalni CAD model) i podrazumeva sledeće korake:

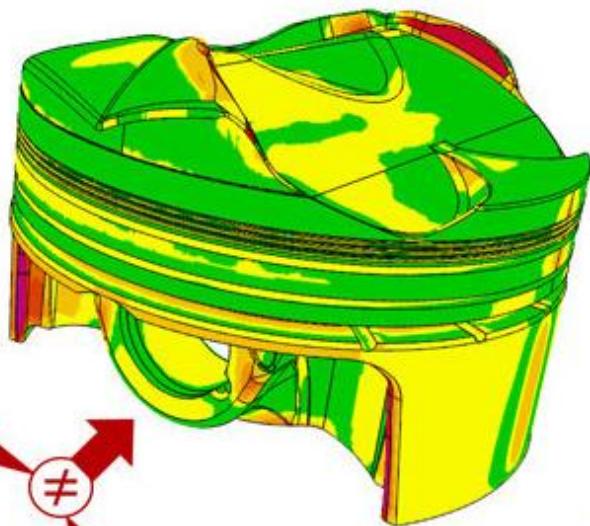
1. 3D digitalizaciju
2. Generisanje površinskog modela – opcionalno
3. Komparaciju sa referentnim CAD modelom



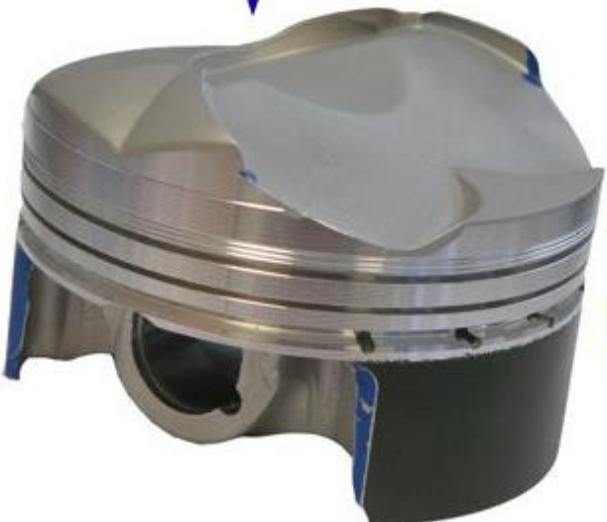
CAD file
- Ideal Design



Comparison CAD / CT Scan
- Visualisation of dimensional defects



Manufacturing



3D Computed
Tomography



Real part

3D data
- Dimensional measurements

Računarom podržana inspekcija

Termini-sinonimi koji se upotrebljavaju za opis ovog procesa, sa manjim ili većim modifikacijama procesa su:

- **Rapid 3D Inspection**
- **računarom podržana verifikacija (computer-aided verification CAV)**
- **3D color comparison-to-CAD**

Zahvaljujući zasnovanosti na CAD-modelu, ova vrsta inspekcije je postala poznata pod nazivom **CAD-inspekcija**.

Reverse Engineering Workflow



CAD-INSPEKCIJA

CAD-inspekcija podrazumeva korišćenje CAD-modela proizvoda, odnosno njegovih parametara, sa ciljem provere geometrijskih i dimenzionalnih odstupanja izrađenog dela ili virtuelnog modela (kreiranog na bazi rezultata 3D digitalizacije).

CAD-inspekcija je, prateći razvoj *CAD* modeliranja, **najpre** bila zasnovana na **2D podacima**, da bi se **zatim** sa pojavom solid modela razvila i **3D CAD-inspekcija**, danas poznata i pod nazivom “*CAD-to-part*” inspekcija, koja podrazumeva proveru odstupanja geometrije realnog proizvoda (na bazi njegovog digitalizovanog modela) od nominalne geometrije, definisane *CAD* modelom.

CAD-INSPEKCIJA

Metodologija

Dva osnovna segmenta *CAD*-inspekcije su:

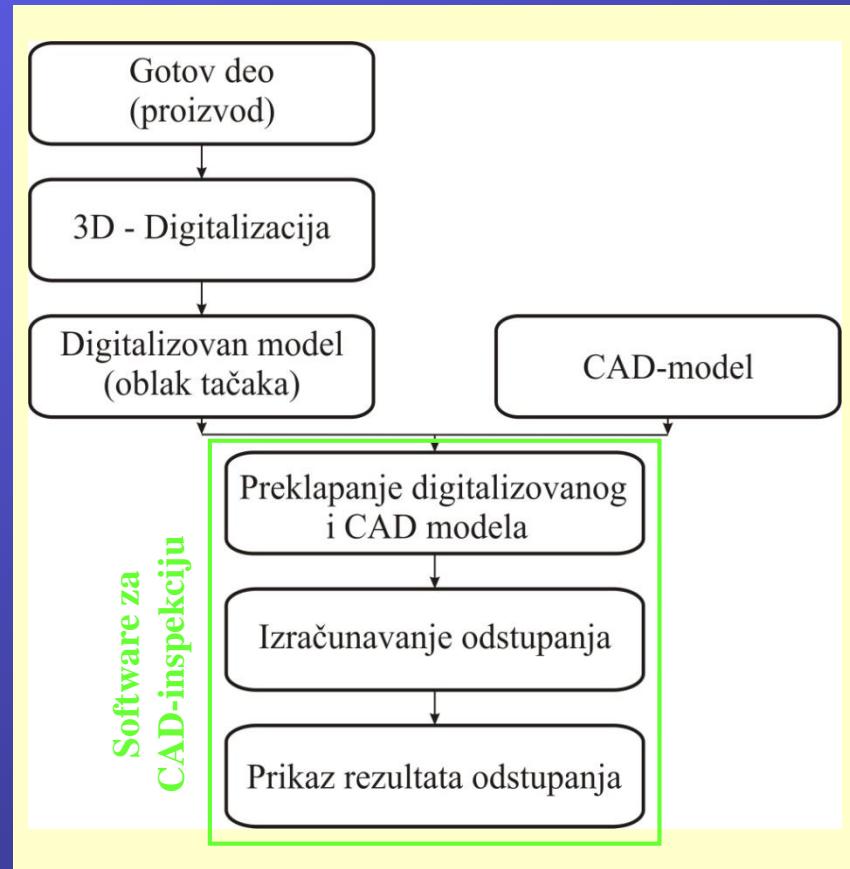
- **3D-digitalizacija** (dominantno hardverski proces) i
- **provera odstupanja** (dominantno softverski proces).

CAD-INSPEKCIJA

Procedura provere odstupanja

Procedura se sastoji u sledećem:

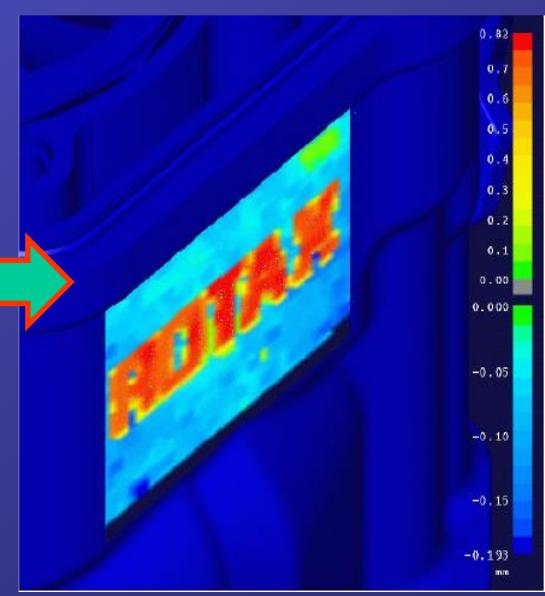
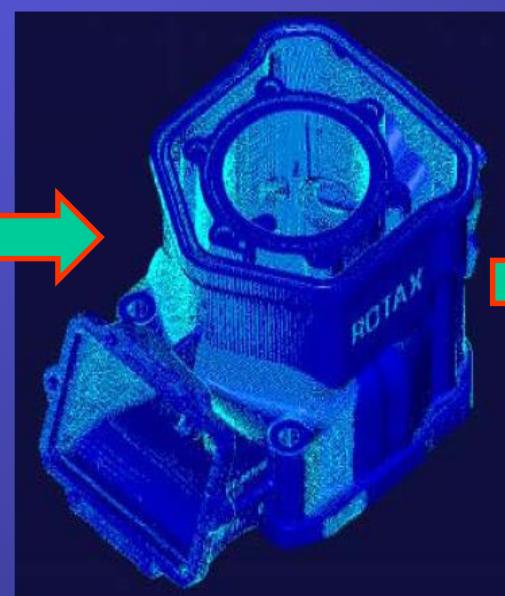
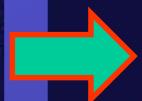
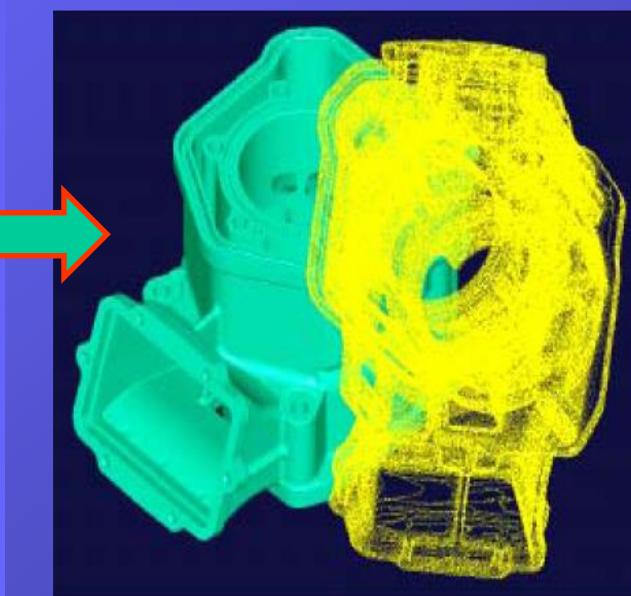
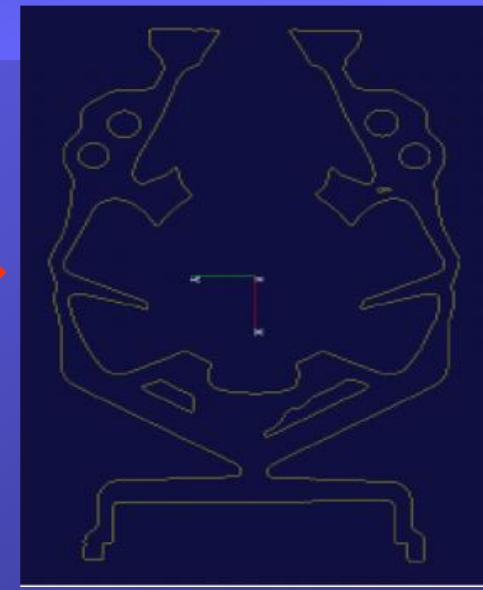
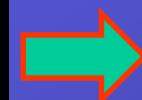
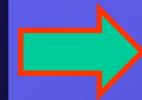
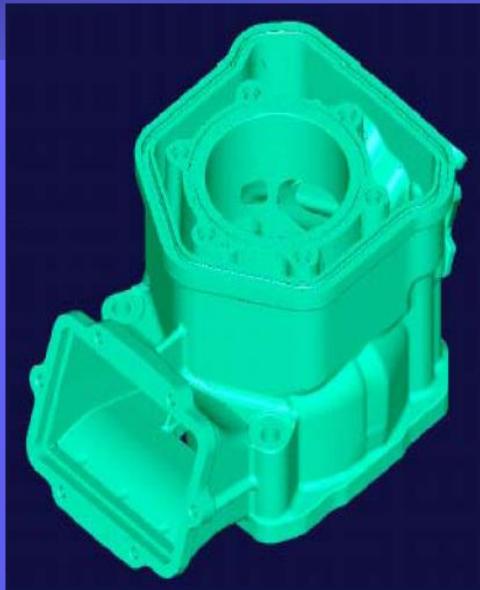
- izrađen deo se digitalizuje nekom od metoda 3D-digitalizacije;
- 3D digitalizovani model (*oblik tačaka*) unosi se u neki od specijalizovanih softvera za CAD-inspekciju, zajedno sa referentnim CAD-modelom;
- sledi orijentisanje digitalizovanog modela prema CAD-modelu u cilju njihovog međusobnog preklapanja;
- potom se vrši izračunavanje nivoa odstupanja digitalizovanog modela od CAD-modela;
- prikaz rezultata odstupanja (mogu se dobiti i u grafičkom obliku radi lakše preglednosti).



Algoritamski prikaz toka procesa

CAD-INSPEKCIJA

Procedura provere odstupanja





Qualify Report

Title: Injector Plate Inspection Report

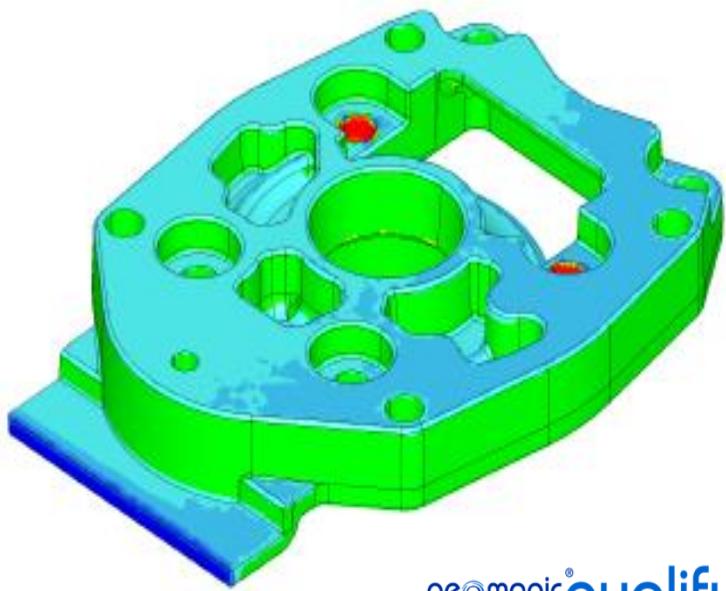
Author: Kevin Scofield

Client: ACME Manufacturing

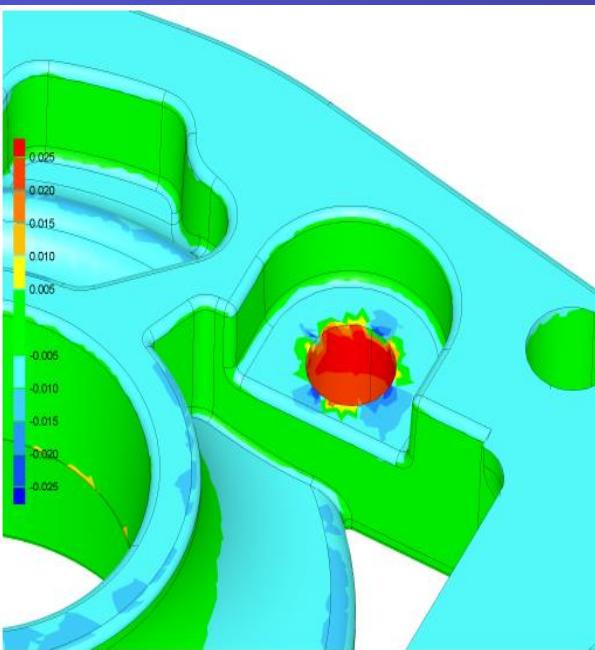
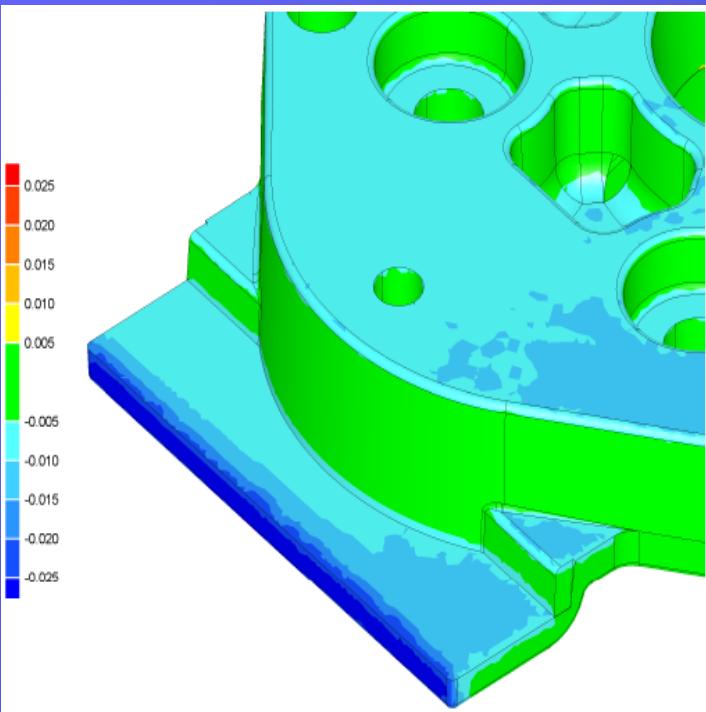
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Test: Injector_plate-SCAN

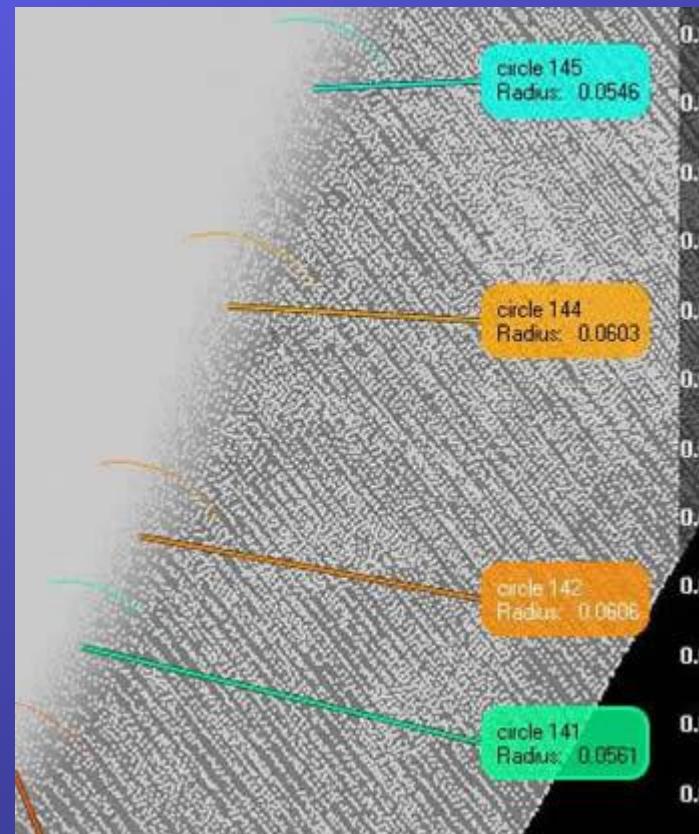
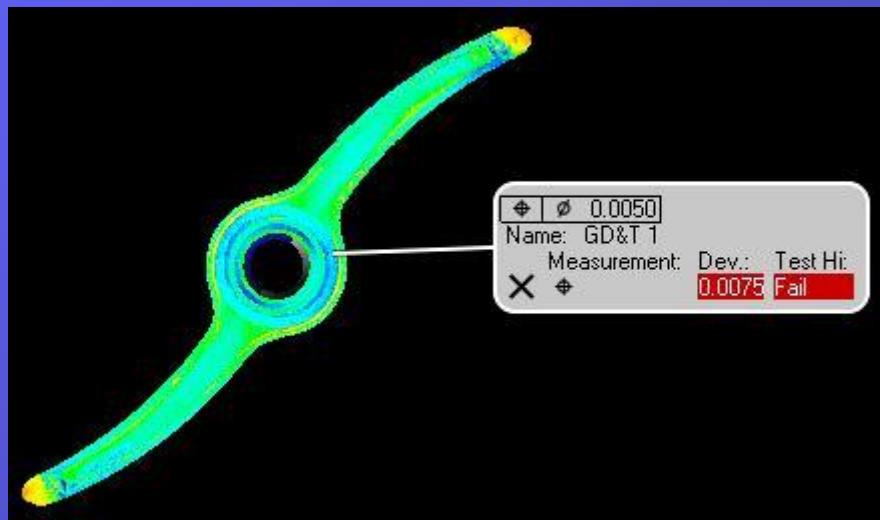
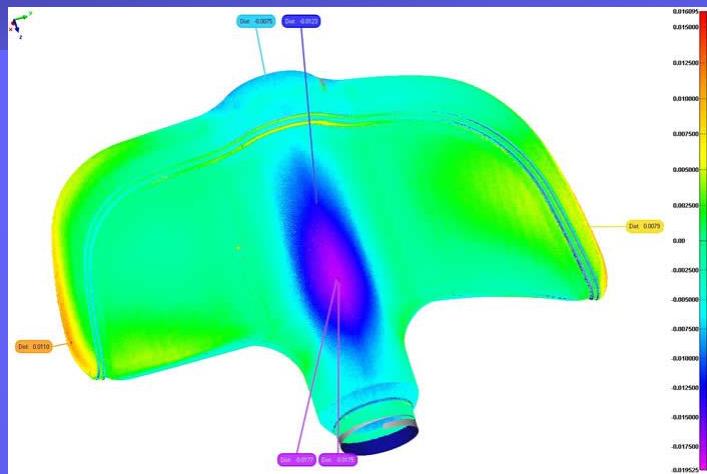
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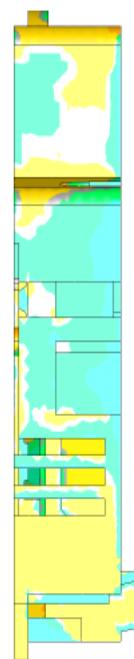
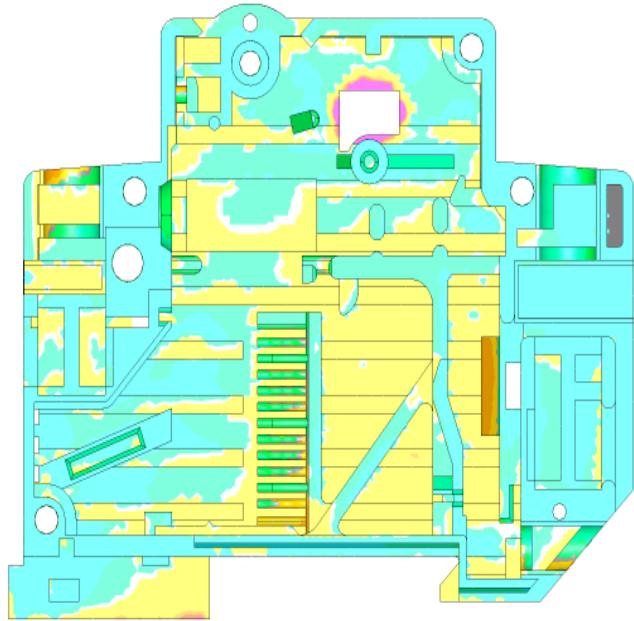
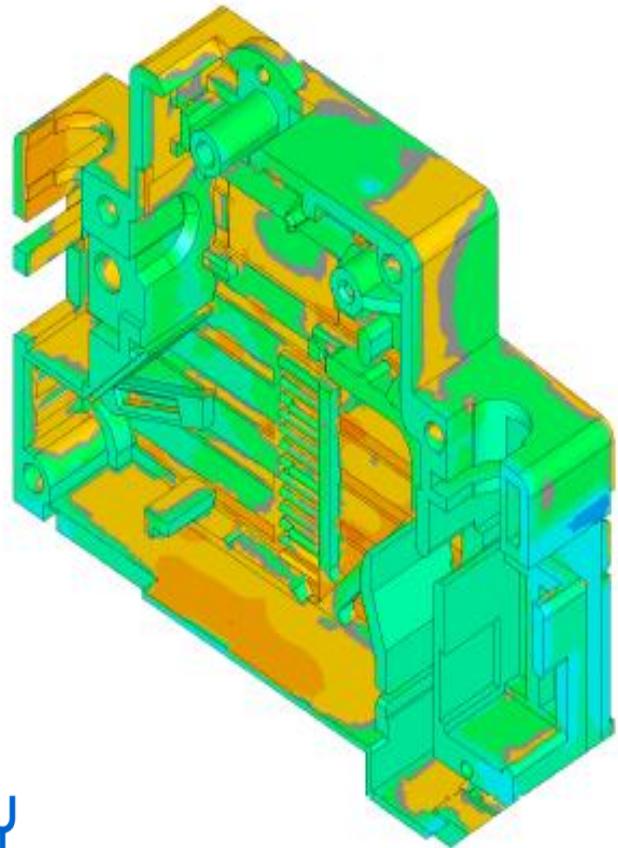
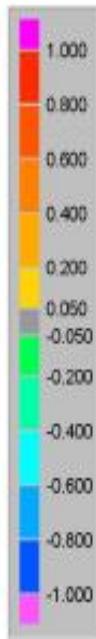
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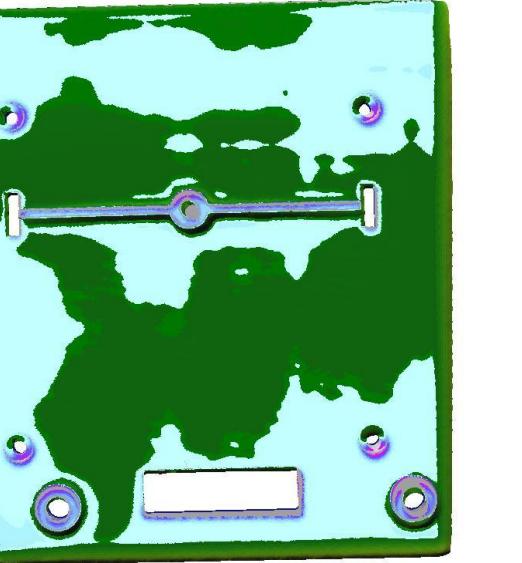
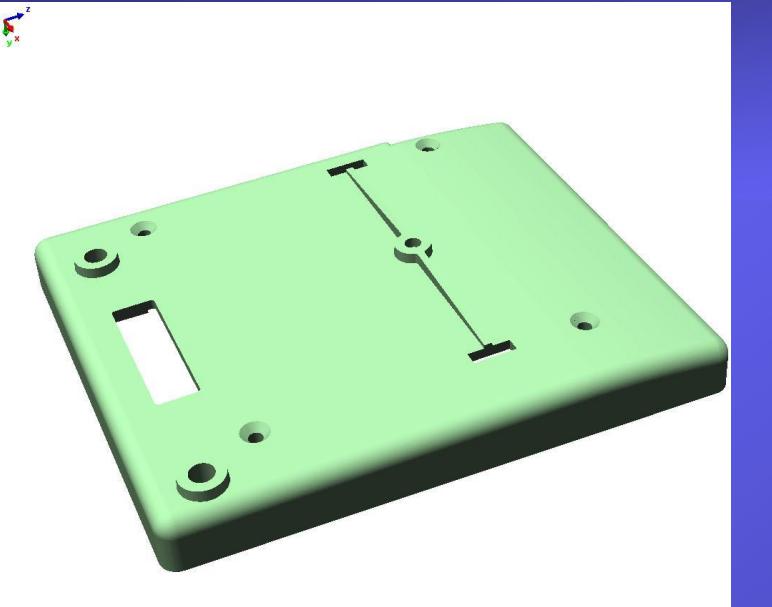


**CAD-INSPEKCIJA
kod obrade rezanjem**

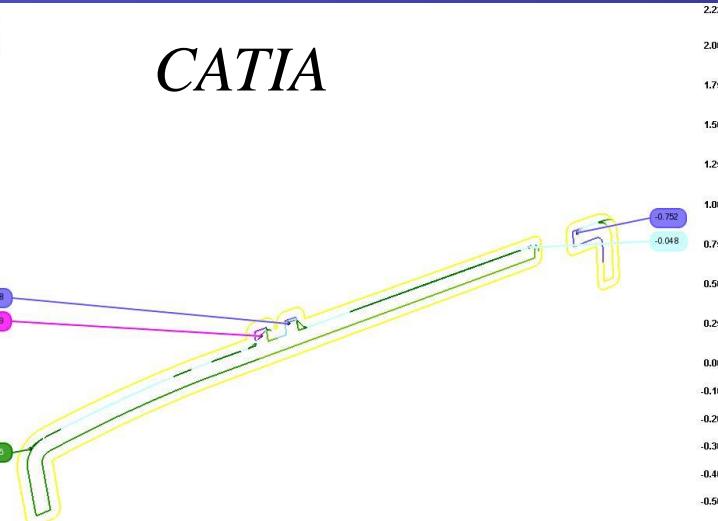


CAD-INSPEKCIJA dela brizganog od plastike



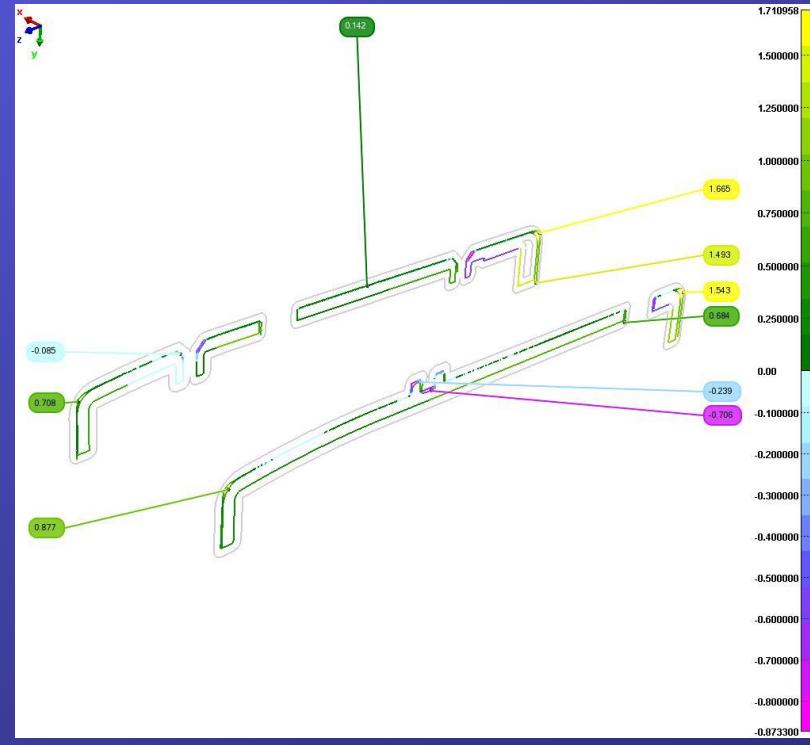
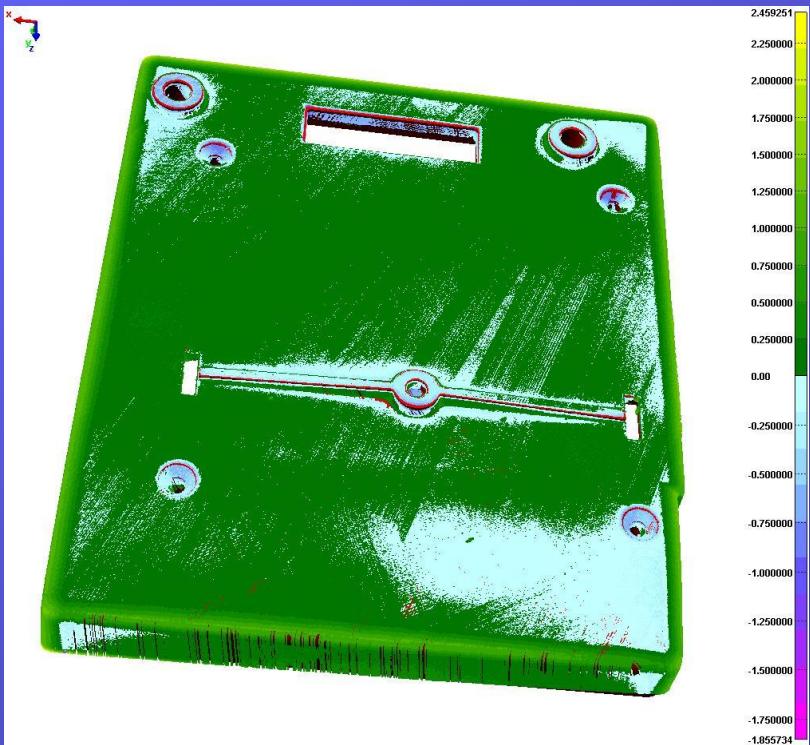


laser scanner MINOLTA VI – 900



CATIA

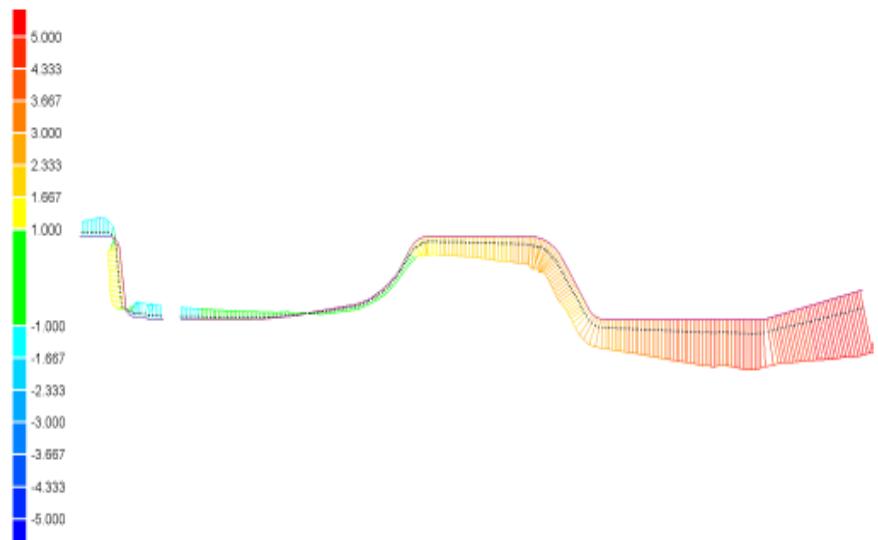
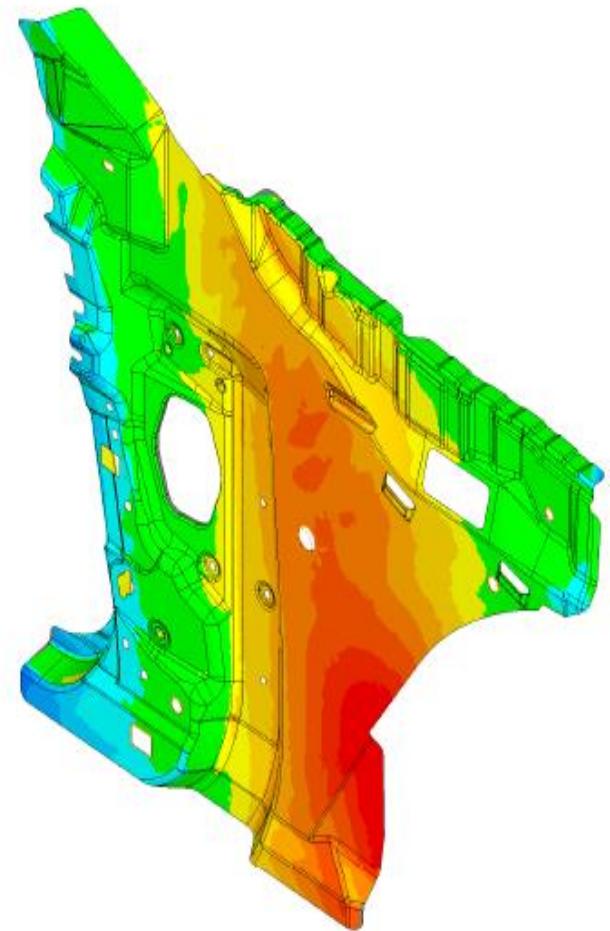
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CAD-INSPEKCIJA kod obrade deformisanjem

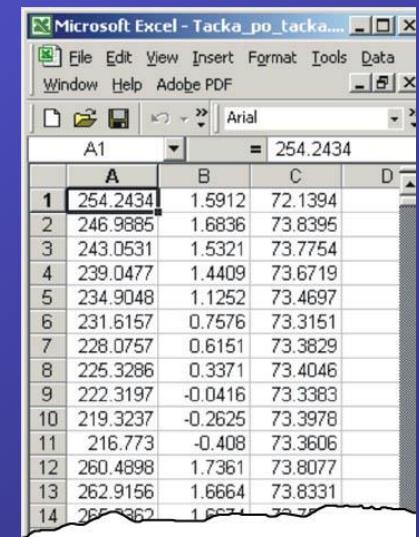
Qualify Report

Title: Sheet Metal Example Report
Author: John Smith
Client: Ford Motor Co.
Part: SM-56G
Test: Sheet Metal - Scan
4/30/2003, 5:44 pm



CAD-INSPEKCIJA

klipa “FIAT ø80”- AD “MOTINS”

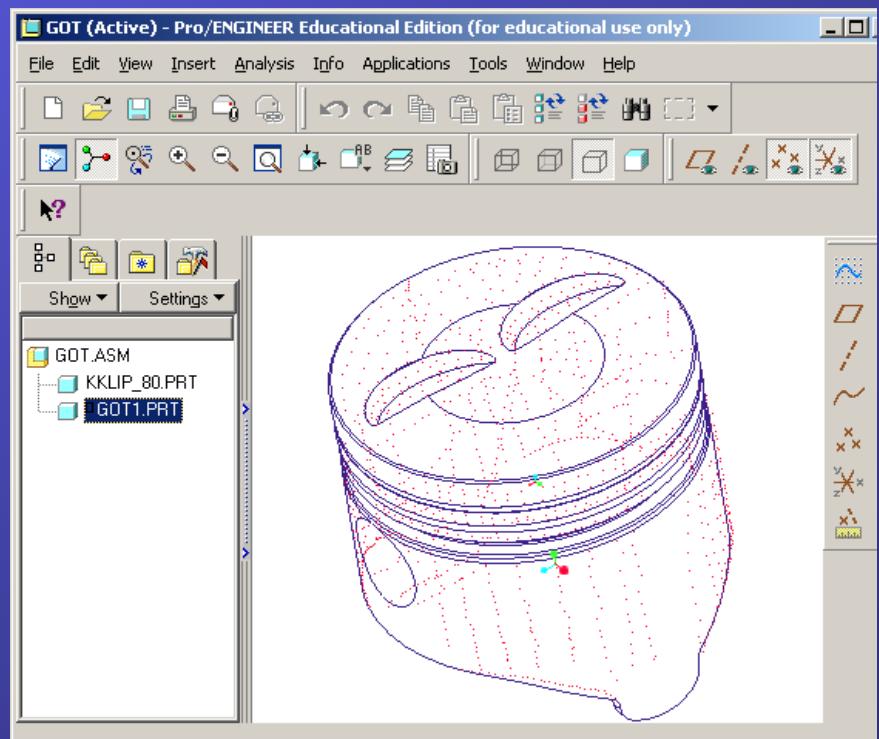
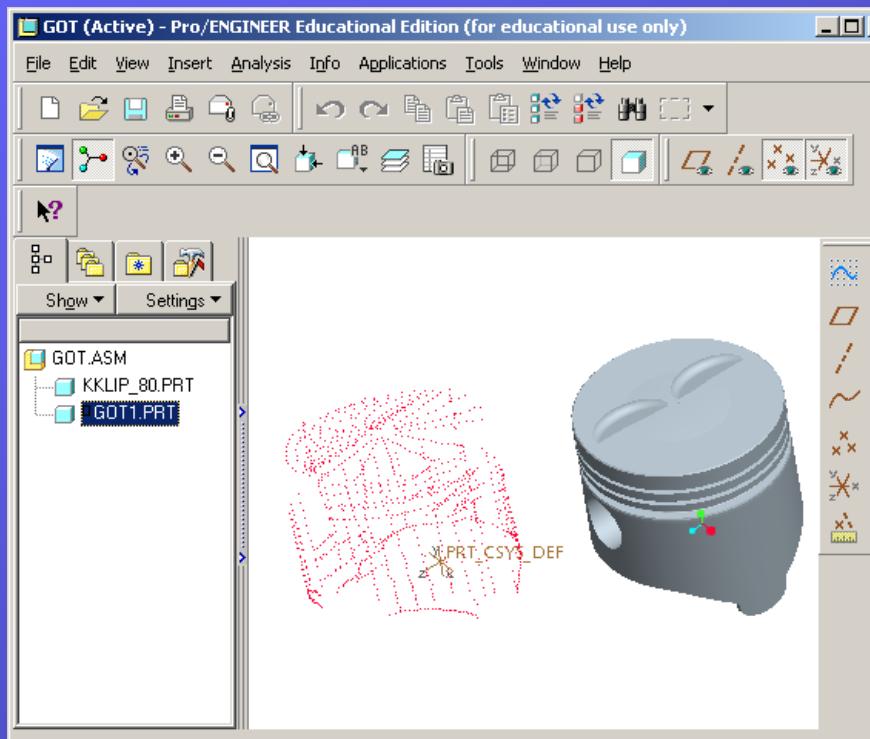
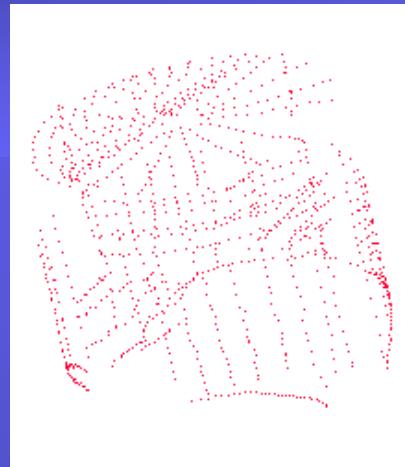


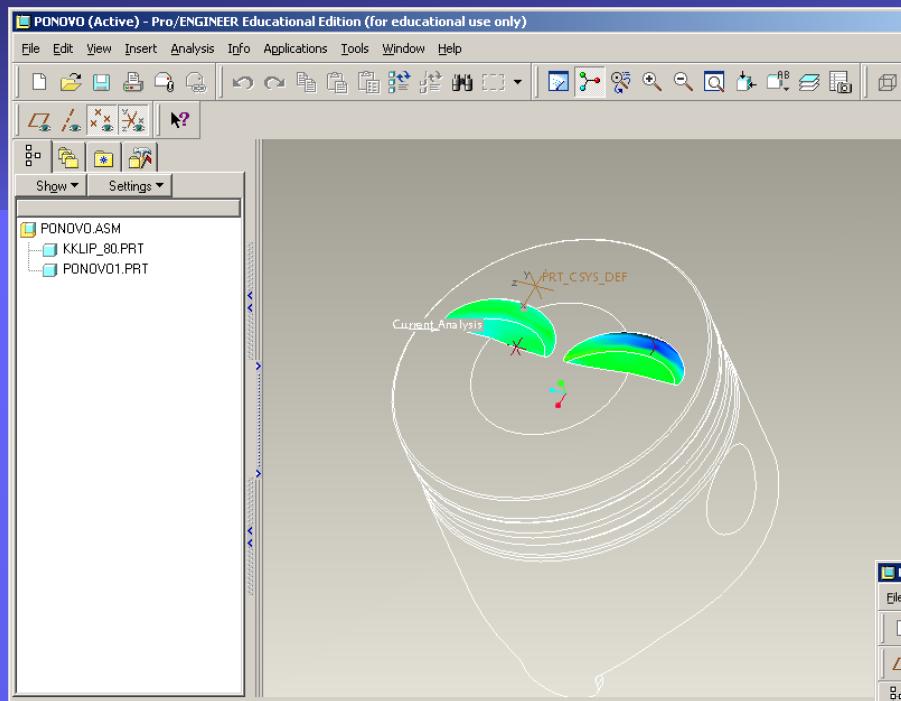
3D-digitalizacija na 3D-digitajzeru MicroScribe G2X (1093 tačke)

CAD-INSPEKCIJA

klipa "FIAT o80"- AD "MOTINS"

*Provera odstupanja u Pro/E
modulu Pro/VERIFY*



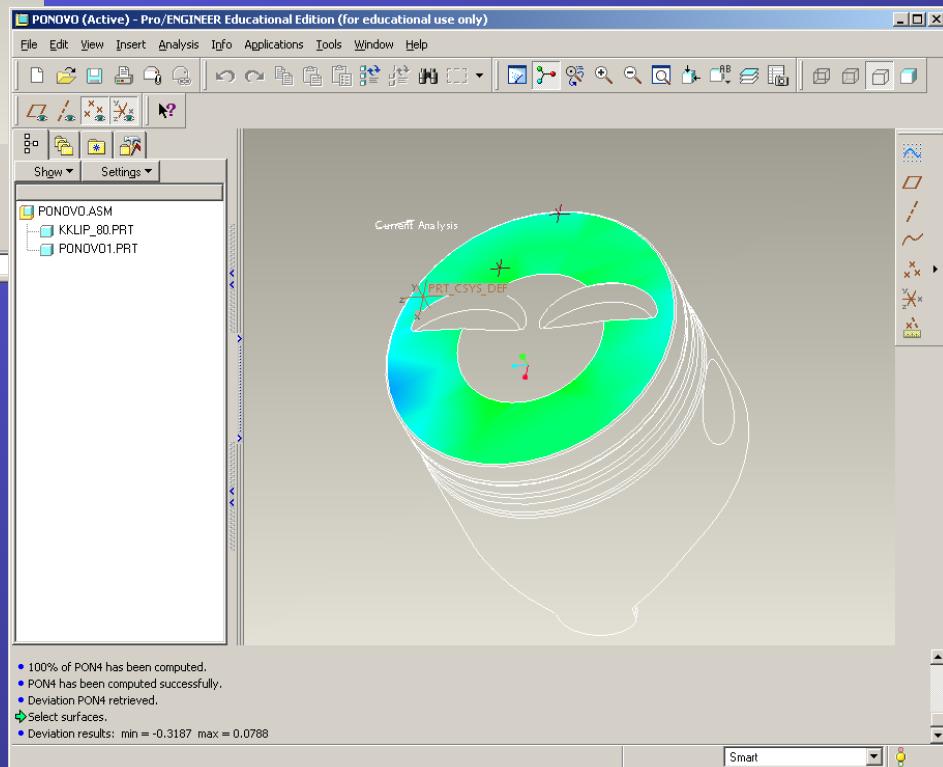


- Deviation PONOVO3 retrieved.
- Deviation results: min = -0.4003 max = 0.1048
- Select surfaces.
- Deviation results: min = -0.4003 max = 0.1048
- Hidden lines will not be displayed.

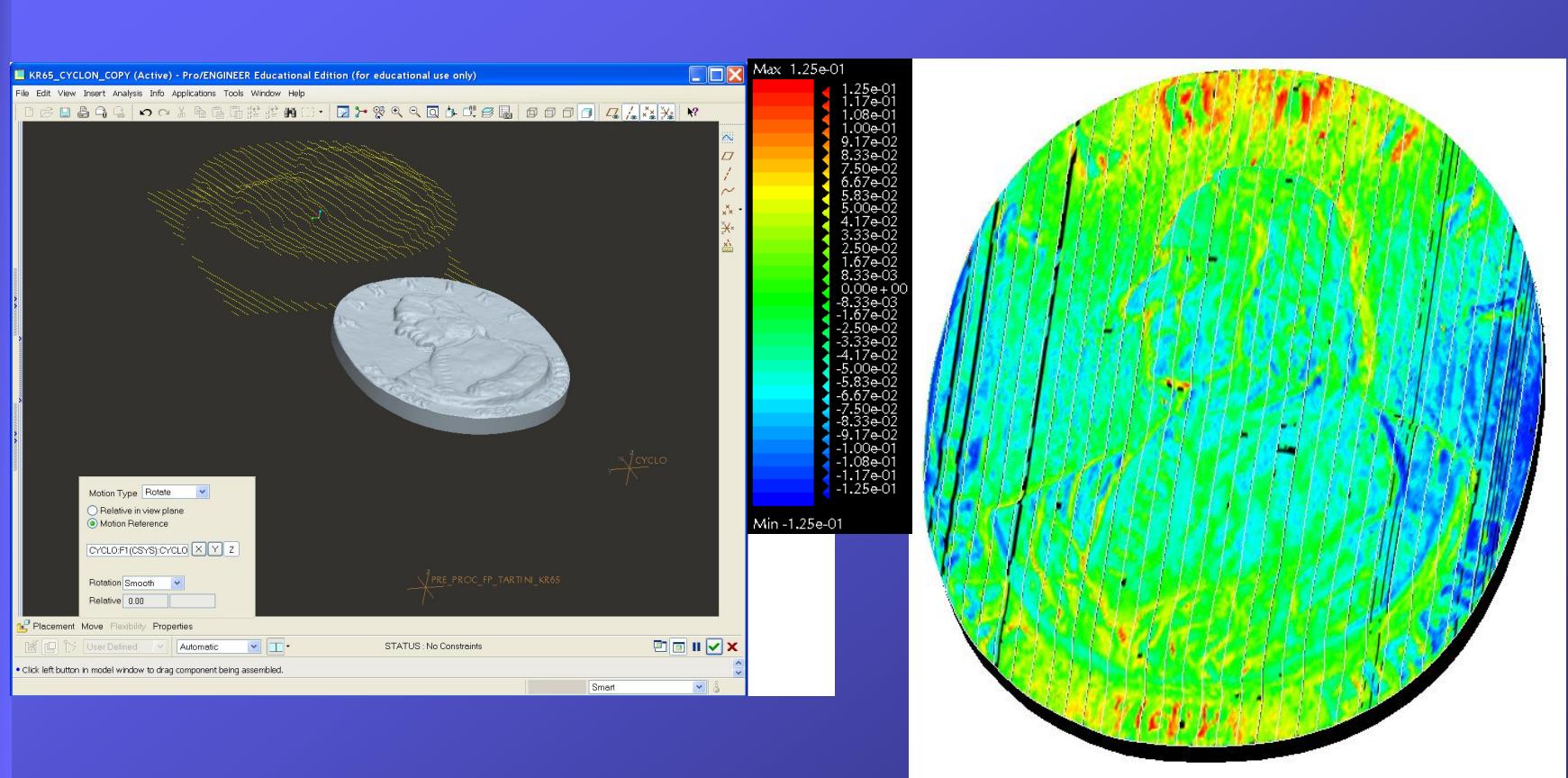
CAD-INSPEKCIJA

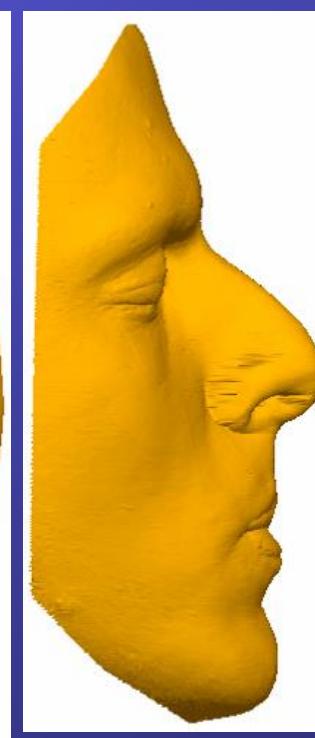
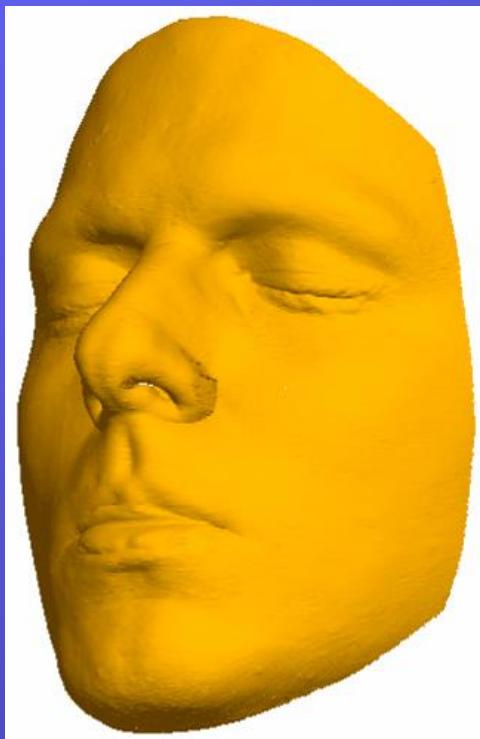
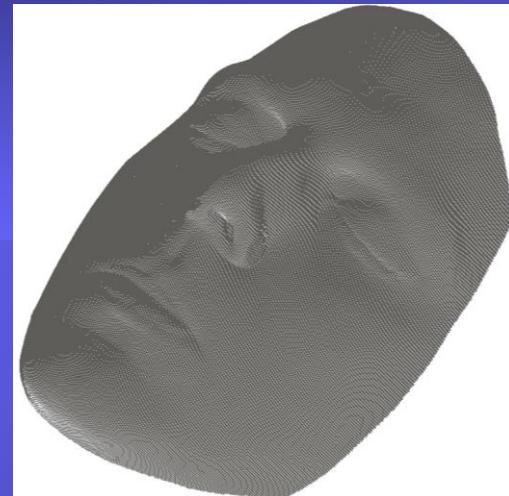
klipa "FIAT ø80"- AD "MOTINS"

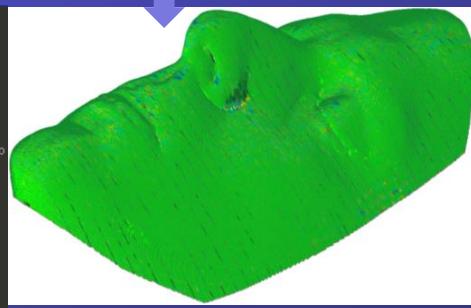
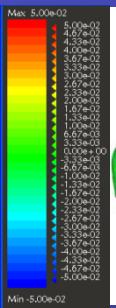
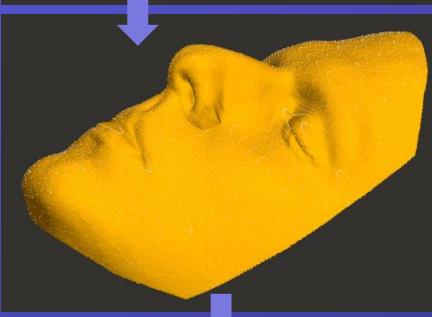
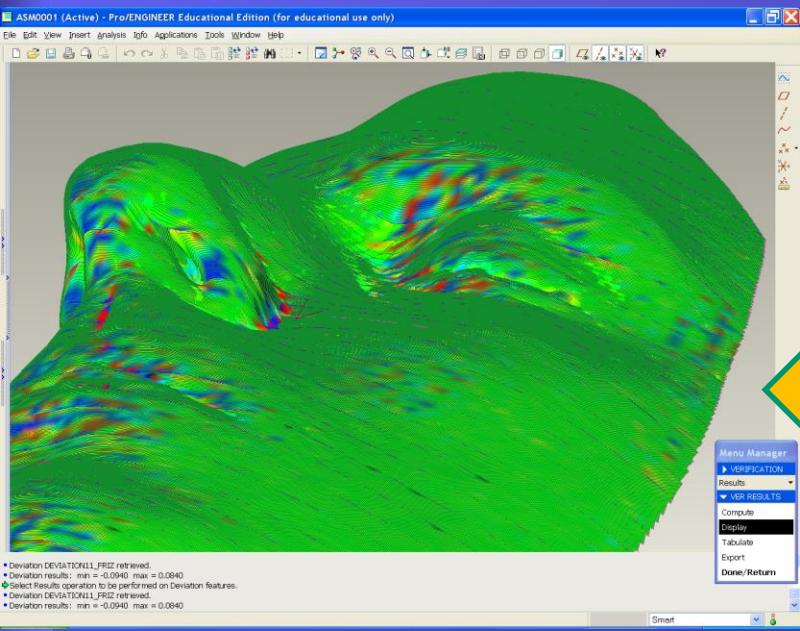
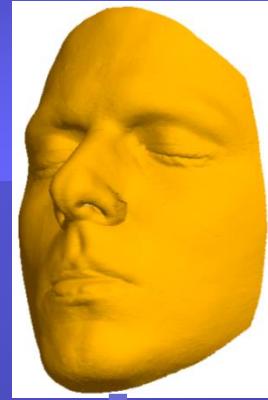
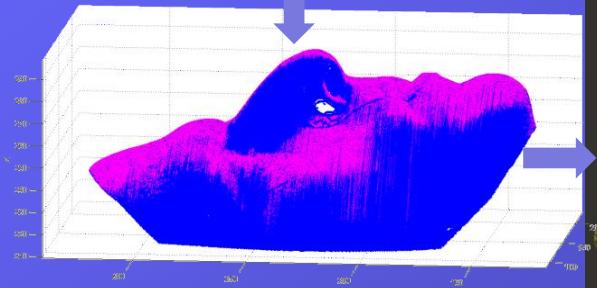
*Rezultat odstupanja
u Pro/VERIFY*

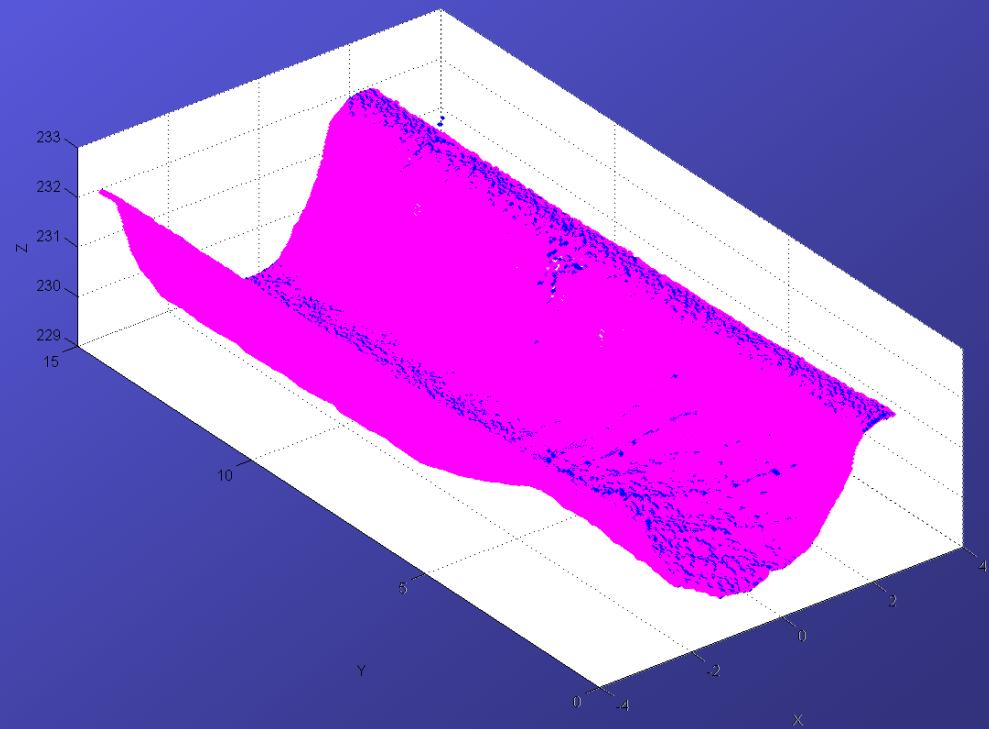
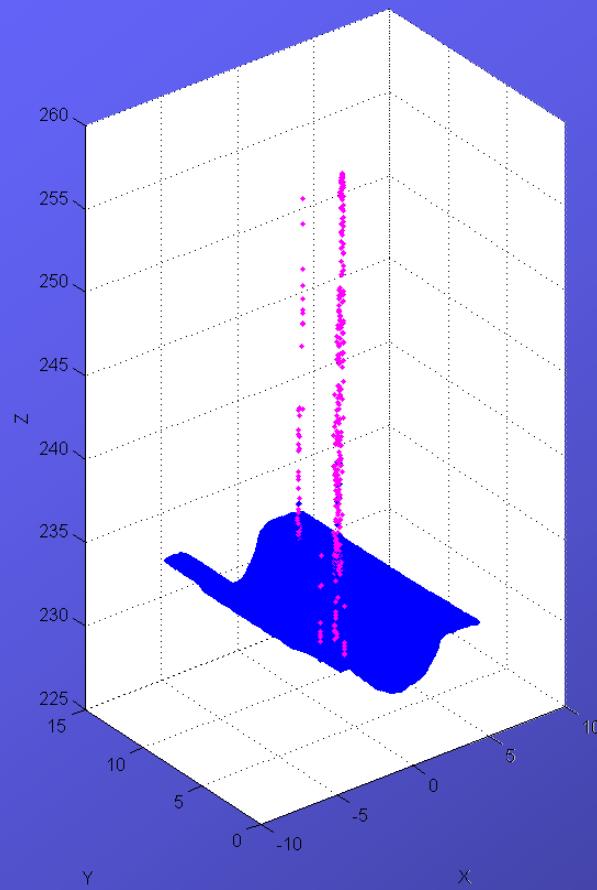
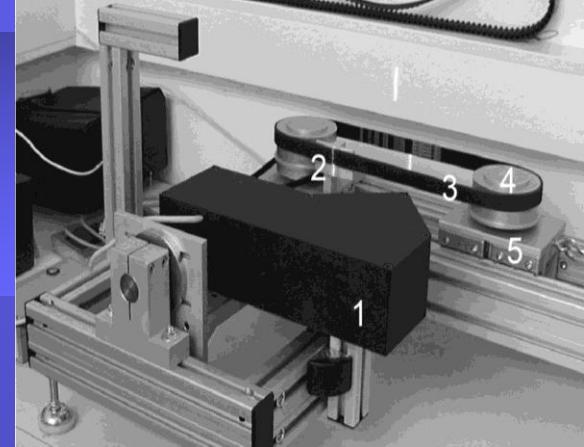


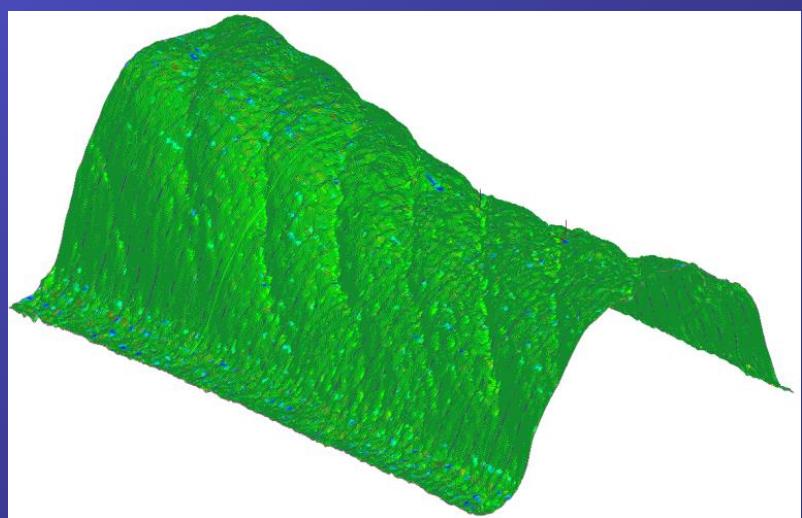
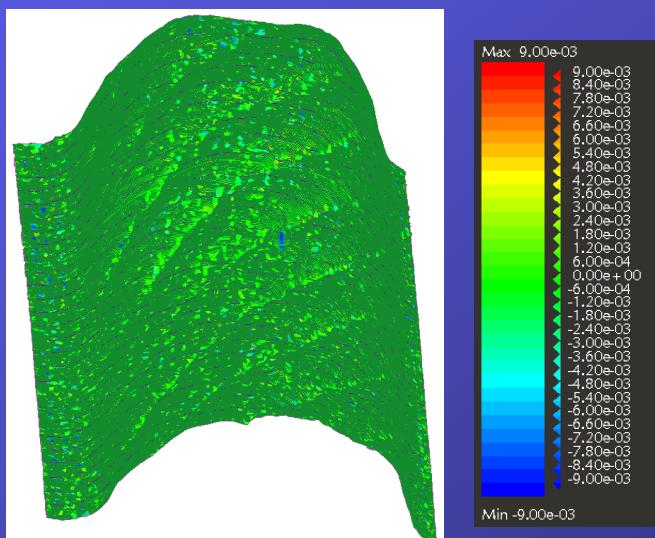
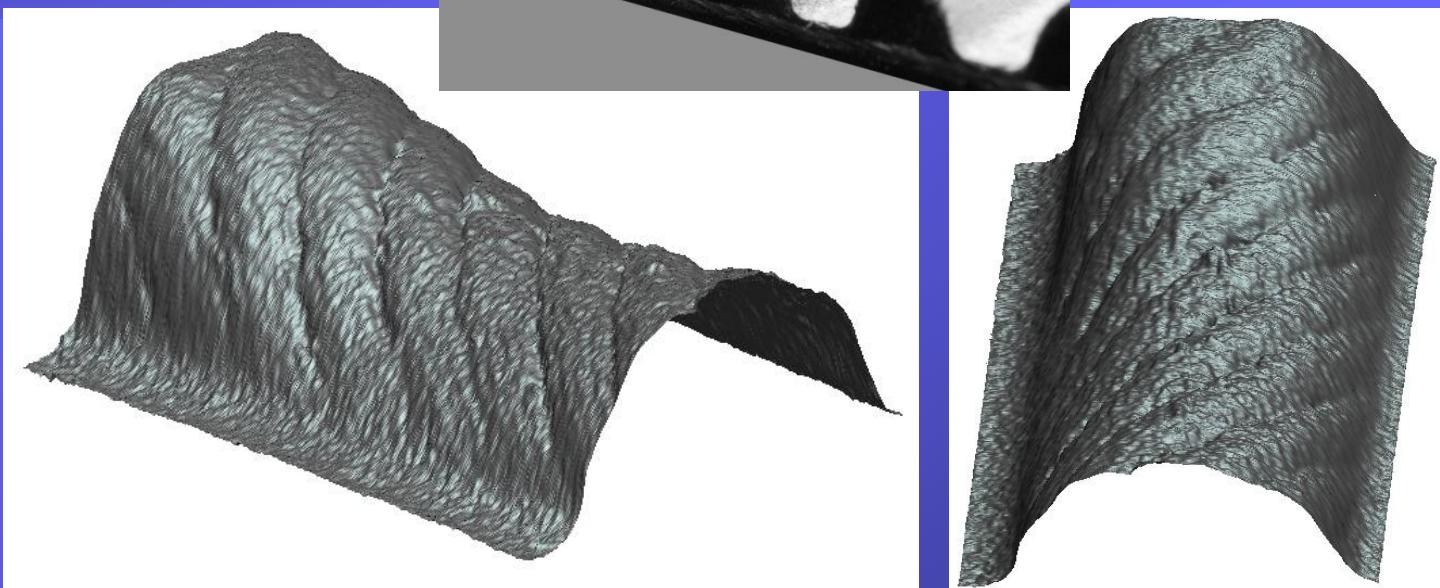
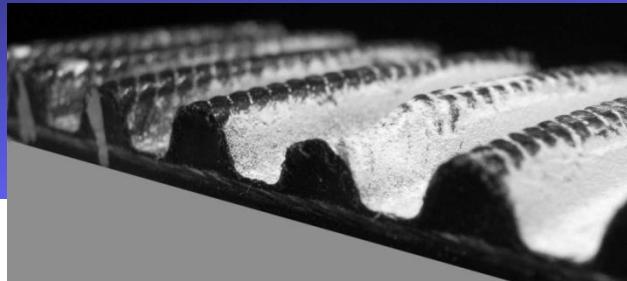
- 100% of PON4 has been computed.
- PON4 has been computed successfully.
- Deviation PON4 retrieved.
- Select surfaces.
- Deviation results: min = -0.3187 max = 0.0788

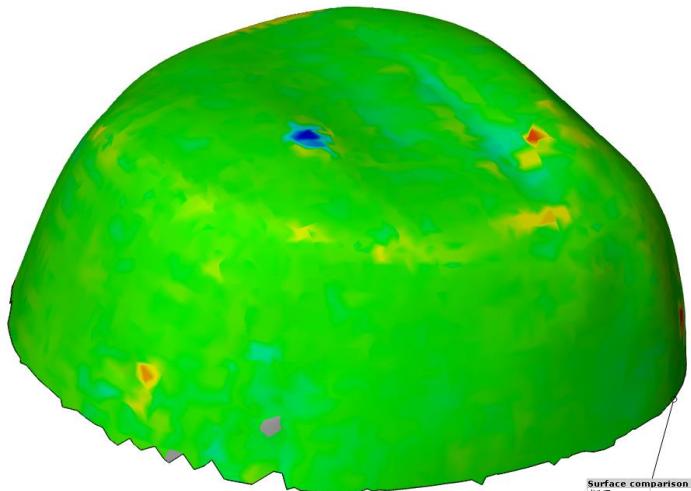




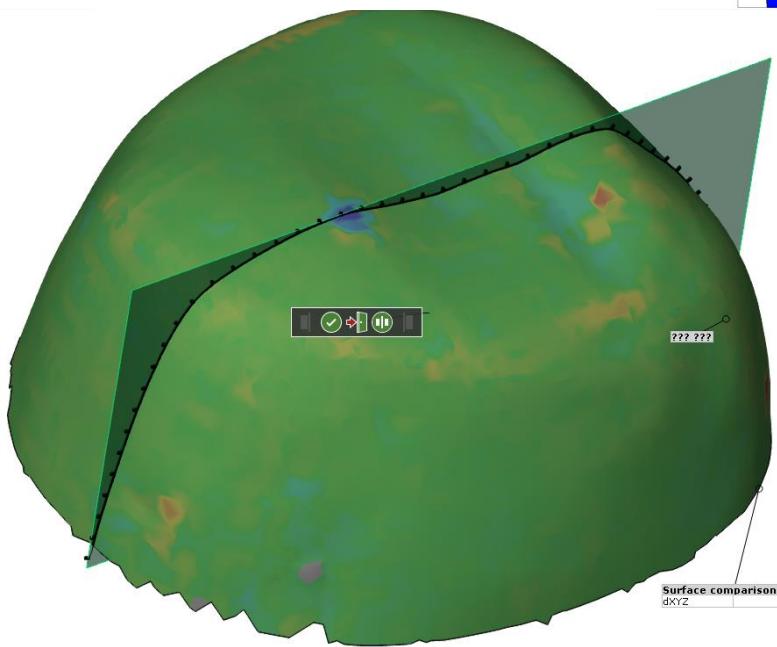
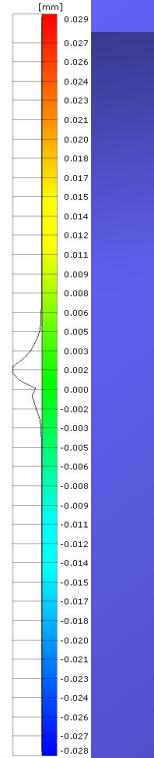








Surface comparison 1
dXYZ



Surface comparison 1
dXYZ

