OUTLINE

SUMMARY

- ANTECEDENTS
  - HOBBIES Technology LTD
  - Important milestones

- HOBBIES EM-SUITE 2016
  - Main features
  - Solving electromagnetic problems

- APPLICATIONS
  - Waveguide structures
  - Antenna Design
  - Antenna placement
  - Scattering analysis
  - EMC/EMI analysis
  - Other applications
HOBBIES is a software developed by HOBBIES Technology LTD & OHRN Enterprises Inc.
HOBBIES has been developed since 2008 in collaboration with
  – GiD team (CIMNE)
  – Compass Ingeniería y Sistemas, S.A

First commercial version in June 2012
  – HOBBIES Academic/Professional version 10 (Based on GiD 10)
  – Academic version 10 maybe found inside the book
    “HIGHER ORDER BASIS BASED INTEGRAL EQUATION SOLVER”
In 2013 HOBBIES run 8192 cores simulation at Shanghai Supercomputer Center
   – First electromagnetic software running in such amount of cores

HOBBIES becomes electromagnetic software suite in 2014
   – FEM solver added
   – New GUI based on wizard approach
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Wizard based graphical user interface

Simulation performed in five steps
- Geometry modeling
- Electromagnetic parameters setup
- Meshing the model
- Running the simulation
- Visualizing the results

HOBBIES tools
- Online updates
- Navigation tree
- Model parametrization
- Internal view for volumetric meshes
- h-adaptive mesh generation
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GEOMETRY MODELING

STEP 1

➢ BASIC GID TOOLS
  – Points
  – Straight lines
  – Arcs
  – NURBS lines
  – NURBS Surfaces
  – Volumes
  – Objects
  – Copy/Move operations

➢ HOBBIES TOOLS
  – Model parametrization
  – Mesh truncation (FEM)
  – Layer integration
BASIC GID TOOLS
- Points
- Straight lines
- Arcs
- NURBS lines
- NURBS Surfaces
- Volumes
- Objects
- Copy/Move operations

HOBBIES TOOLS
- MODEL PARAMETRIZATION
- Mesh truncation (FEM)
- Layer integration
GEOMETRY MODELING
STEP 1

➤ BASIC GID TOOLS
   – Points
   – Straight lines
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➤ HOBBIES TOOLS
   – Model parametrization
   – Mesh truncation (FEM)
   – LAYER INTEGRATION
ELECTROMAGNETIC PARAMETERS SETUP
STEP 2

- MATERIALS
  - CREATE/EDIT
  - Delete
  - Assign/Unassign
  - View

![Image of software interface showing materials setup]

Press ESC to exit from object view.
Command:
MATERIALS
- CREATE/EDIT
- Delete

ELECTROMAGNETIC PARAMETERS SETUP
STEP 2
ELECTROMAGNETIC PARAMETERS SETUP

STEP 2

- MATERIALS
  - Create/Edit
  - DELETE
  - Assign/Unassign
  - View
ELECTROMAGNETIC PARAMETERS SETUP
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ELECTROMAGNETIC PARAMETERS SETUP

STEP 2

- **BOUNDARY CONDITIONS**
  - PEC/PMC/ABC/PORTS
  - Assign/unassign
  - View
ELECTROMAGNETIC PARAMETERS SETUP

STEP 2

- BOUNDARY CONDITIONS
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BOUNDARY CONDITIONS

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ELECTROMAGNETIC PARAMETERS SETUP
STEP 2

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ELECTROMAGNETIC PARAMETERS SETUP

STEP 2

- **EXCITATIONS**
  - **CREATE/EDIT**
    - **WAVEPORTS**
    - Planewaves
    - Delete
    - View
ELECTROMAGNETIC PARAMETERS SETUP

STEP 2

- EXCITATIONS
  - CREATE/EDIT
    - Waveports

![Waveport Setup](image-url)

**Create single wave**

**Wave polarization**

<table>
<thead>
<tr>
<th>Component</th>
<th>Real</th>
<th>Imag</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\phi$</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>$\theta$</td>
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<td>0.0</td>
</tr>
</tbody>
</table>

**Incident angles**

<table>
<thead>
<tr>
<th>Angle</th>
<th>$\phi$-angle</th>
<th>$\theta$-angle</th>
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</thead>
<tbody>
<tr>
<td>Angles</td>
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![Angle Setup](image-url)

**Wave polarization**

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![Additional waveport](image-url)
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STEP 2

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ELECTROMAGNETIC PARAMETERS SETUP

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EXCITATIONS

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MESHING MODEL

STEP 3

- **GID TOOLS**
  - Unstructured
  - Structured
  - Vol. Meshes
  - Sur. Meshes

- **HOBBIES TOOLS**
  - Entity mesh view
  - Quality view
    - Min/Max. angles
    - Min/Max. edges
    - Min. Jacobian
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RUNNING SIMULATION

STEP 4

- **FREQUENCY**
  - Single frequency
  - Frequency sweep

- **SOLVER OPTIONS**
  - Parallel/Serial
  - In-core/Out-of-core
  - MPI+Threads
  - Mesh adaptivity

- **REMOTE SIMULATION**
  - Posidonia tool
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VISUALIZING THE RESULTS
STEP 5

- **GID POSTPROCESS**
  - Transparent switch

- **HOBBIES TOOLS**
  - Adaptive mesh process
  - 2D/3D Nearfield
  - 2D/3D Farfield
  - Network parameters
VISUALIZING THE RESULTS

STEP 5

- **GID POSTPROCESS**
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- **HOBBIES TOOLS**
  - **ADAPTIVE MESH PROCESS**
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APPLICATIONS
- WAVEGUIDE STRUCTURES
- Antenna Design
- Antenna placement
- Scattering analysis
- EMC/EMI analysis
- Other applications
CIRCULATOR @ 15 GHz
- Rotation structure
- Only one output port
- Lossy dielectric
- Anisotropic materials
  • Uses of Ferrites
APPLICATIONS: WAVEGUIDE STRUCTURES
WAVEGUIDE CIRCULATOR

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APPLICATIONS: WAVEGUIDE STRUCTURES
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APPLICATIONS: ANTENNA DESIGN
CIRCULAR HORN ANTENNA

- **HORN ANTENNA @ 10 GHz**
  - Metal structure
  - Mesh truncation
    - Use of FE-IIEE
  - Directivity calculation
APPLICATIONS: ANTENNA DESIGN
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Airborne 2160-Element Slotted Waveguide Phased Array

- Parallel hybrid MoM-PO method is used with the array in MoM region and the airplane in PO region.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>MoM Unknowns</th>
<th>PO triangles</th>
<th>RAM/HDD</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.375 GHz</td>
<td>190.000</td>
<td>2.550.000</td>
<td>600 GB</td>
<td>SSC</td>
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</tbody>
</table>
Applications: Antenna Placement
Helicopter

- Antenna analysis mounted on a helicopter

3D Radiation pattern

<table>
<thead>
<tr>
<th>Frequency</th>
<th>MoM Unknowns</th>
<th>RAM/HDD</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>130 MHz</td>
<td>76,000</td>
<td>90 GB</td>
<td>HPC</td>
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</table>
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APPLICATIONS: SCATTERING ANALYSIS
NASA BENCHMARKS

HORN ANTENNA @ 10 GHz
- Metal structure
- Mesh truncation
  - Use of FE-IIEE
- Directivity calculation

<table>
<thead>
<tr>
<th>Frequency</th>
<th>9.92 GHz</th>
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</thead>
<tbody>
<tr>
<td>Plane</td>
<td>Azimuth</td>
</tr>
<tr>
<td>Polarization</td>
<td>θθ (horizontal)</td>
</tr>
<tr>
<td>Platform</td>
<td>Laptop</td>
</tr>
</tbody>
</table>

Success in RCS analysis for NASA benchmarks: NASA Almond, Ogive, Double ogive, Cone-sphere

APPLICATIONS: SCATTERING ANALYSIS
NASA BENCHMARKS

Applications: Scattering Analysis

- Bistatic RCS of JINA 2006 Almond

Specifications:

- **Size**: 2.5 meters
- **Frequency**: 8 GHz
- **Planewave**: Incident x-axis
- **Polarization**: ΦΦ (vertical), θθ (horizontal)
- **Unknowns**: 315,000
- **RAM/HDD**: 1.58 TB
- **Time**: 12.2 hours
- **Platform**: SSC
RCS of Apache Helicopter

- **Length**: 17.7 m (47.2 λ)
- **Width**: 14.6 m (38.9 λ)
- **Height**: 3.8 m (10.13 λ)
- **Frequency**: 800 MHz
- **Planewave**: Φ = 90° (morro)
- **Polarization**: ΦΦ (vertical)
- **Unknowns**: 255.000
- **RAM/HDD**: 968.94 GB
- **Time**: 9.67 hours
- **Platform**: SSC
- **Cores**: 512

Blades: $\varepsilon_r = 4.5$
Wheels: $\varepsilon_r = 4.5$
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Impulse Radiating Antennas (IRA)

- Radiates over a large bandwidth a short impulse
- Antennas appropriate for transient radars (to find buried targets) or to distort the time shape of the received electromagnetic field.

**Applications: EMC/EMI Analysis**

<table>
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<tr>
<th>Frequency</th>
<th>MoM Unknowns</th>
<th>RAM/HDD</th>
<th>Platform</th>
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<tbody>
<tr>
<td>2 GHz</td>
<td>550,000</td>
<td>4.5 TB</td>
<td>HPC</td>
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Impulse Radiating Antennas (IRA)

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Radome design
- After design/optimize your antenna a Radome can be designed using HOBBIES

FSS simulation
- Over curved or flat surfaces
QUESTIONS?
THANK YOU FOR YOUR ATTENTION!

HOBBIES ELECTROMAGNETIC SUITE 2016
HIGHER ORDER BASIS BASED INTEGRAL EQUATION SOLVER

Contact: dgdonoro@gmail.com