

Computer Models For Fire and Smoke

<i>Model Name:</i>	PHOENICS
<i>Version:</i>	FLAIR
<i>Date:</i>	July 2013
<i>Classification:</i>	CFD thermal simulator, finite volume methods
<i>Very Short Description:</i>	FLAIR simulates fire progression, smoke and pollutant dispersion – steady state or transient conditions
<i>Modeler(s), Organization(s):</i>	CHAM Limited – www.cham.co.uk
<i>User's Guide:</i>	FLAIR User Guide TR/313 - www.cham.co.uk/phoenics/d_polis/d_docs/tr313/tr313.htm
<i>Technical References:</i>	Various
<i>Validation References:</i>	Various
<i>Availability:</i>	Monthly, annual & perpetual licensing options
<i>Model Actively Supported?:</i>	Yes
<i>Price:</i>	£4,800 pa commercial – discounts for non-profit R&D, plus further discounts for academic use
<i>Necessary Hardware:</i>	Windows or Linux PC
<i>Computer Language:</i>	FORTTRAN, PHOENICS Input Language, GUI
<i>Size:</i>	300Gb
<i>Contact Information:</i>	Sales@cham.co.uk – www.cham.co.uk

Detailed Description:

See attachment or
www.cham.co.uk/casestudies/FLAIR_description.pdf



The role of PHOENICS/FLAIR CFD software for improving the capabilities of Fire Brigades in the analysis and prognosis of fire and chemical release hazards

GENERAL

PHOENICS/FLAIR is a CFD software package specialising in the simulation of scenarios involving fluid flow, heat transfer, combustion and chemical reaction processes occurring in the built and natural environment.

FLAIR is utilised by architects, design engineers and safety officers concerned with the performance of air-flow systems for both the internal and external environment.

FLAIR enables users to visualise, understand, evaluate and refine the air-flow patterns in steady-state or time-dependent scenarios, in micro- as well as macro-scale.

FLAIR permits the safe investigation of “What-If” scenarios involving ventilation system failures, fires, explosion, gas and chemical releases; and the subsequent effect of remedial action.

FLAIR shows results for:

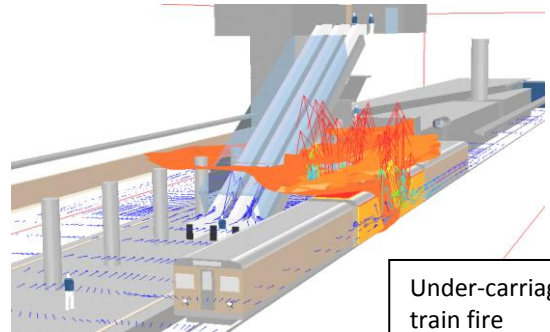
- Air flow patterns
 - Velocity
 - pressure
 - temperature
 - turbulence
- Temperature distribution / stratification
- Radiation
- Humidity
- Thermal comfort
- Age of air / residence time
- Air change effectiveness
- Smoke layering and concentration
- Visibility / line of sight
- Pollutant spread and concentration
- Transport of contaminants
- Effect of sprinkler- and fan- fire control methods





FLAIR contains:

- CAD import and repair features
- Standard objects for diffusers, fans, sprinklers and equipment types
- Heat sources, inlet, outlet and other boundary conditions
- Wind and wind profiling
- Solar gain
- ISO, Green Star and ASHRAE standards
- A library of materials
- A property database
- A relational data input (RDI) feature



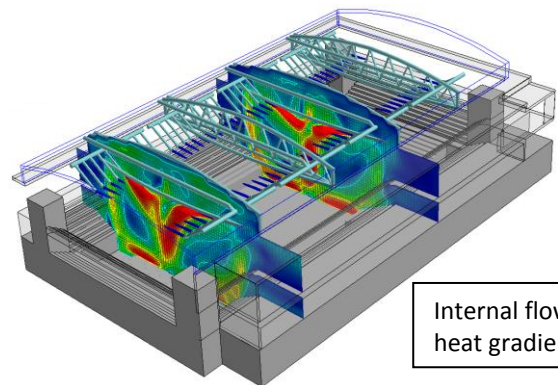
Under-carriage train fire

FLAIR displays:

- Building geometry and terrain data
- Velocity vectors
- Streamlines
- Iso-surfaces
- Contours of pressure, temperature, concentration, relative humidity & thermal comfort parameters
- Animated results

FLAIR permits:

- Addition of user-defined functions
- Addition of user-defined materials
- Addition of user-defined properties



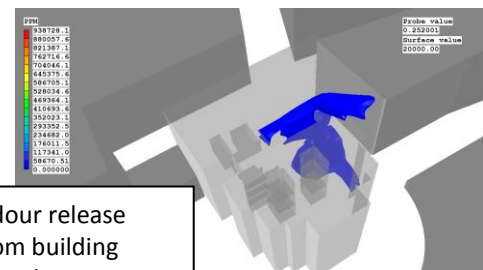
Internal flow heat gradient

FLAIR applications include:

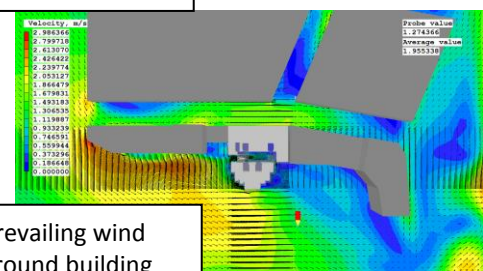
- Heating, ventilation and air conditioning, thermal comfort
- Fire and smoke hazards
- Chemical release and pollution spread
- Wind loading on structures

FLAIR cases include:

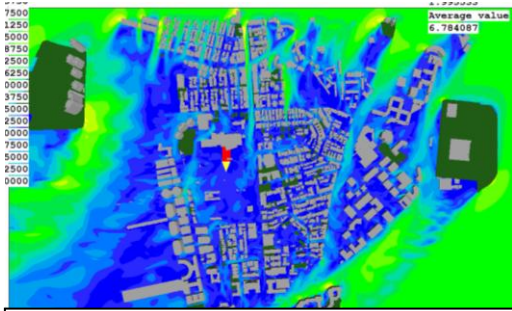
- Atria
- Building complexes
- Car parks
- Clean Rooms
- Furnaces & incinerators
- Railway stations
- Sports stadia
- Cityscape street canyons
- Road and rail tunnels
- Hilly terrain



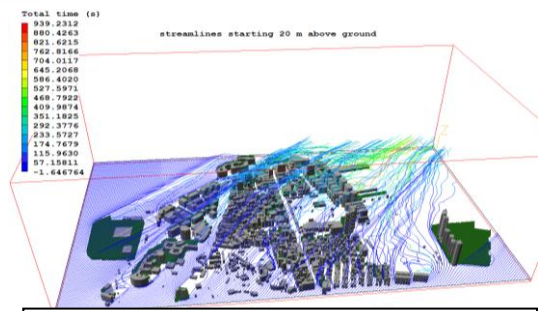
Odour release from building complex



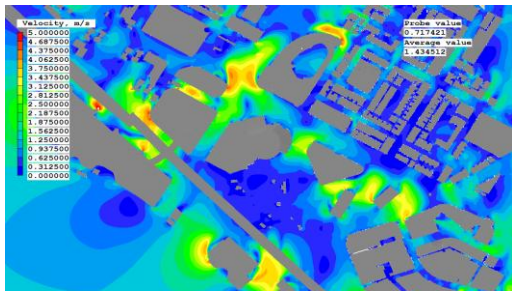
Prevailing wind around building complex



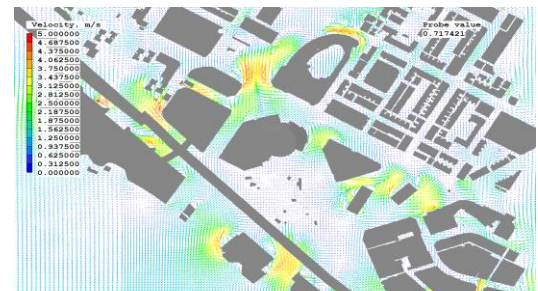
Flow around buildings



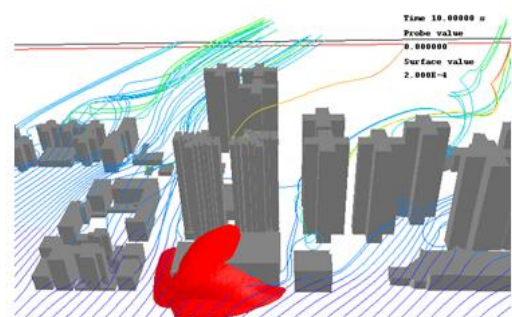
Flow around buildings



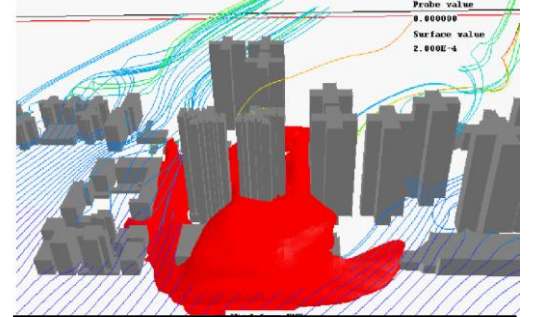
Flow around buildings



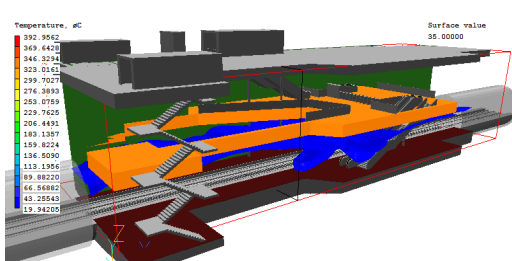
Flow around buildings



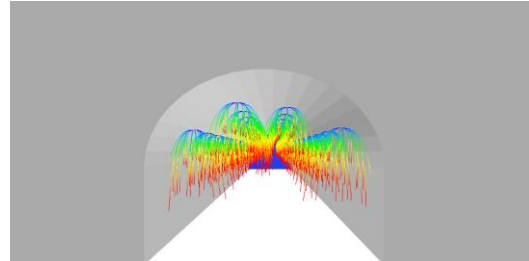
Pollution spread around buildings



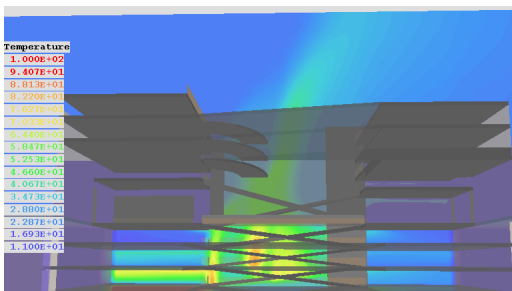
Pollution spread around buildings



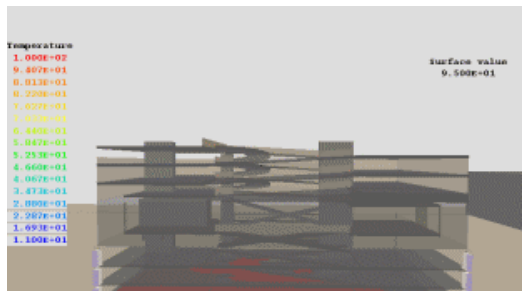
Fire in an underground railway station



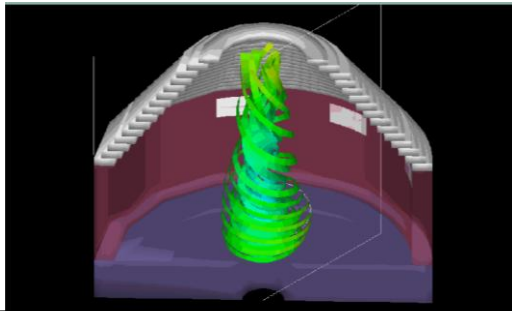
Activation of sprinklers / temperature layer



Fire in a multi-storey car park



Fire in a multi-storey car park



Streamlines of combustion product

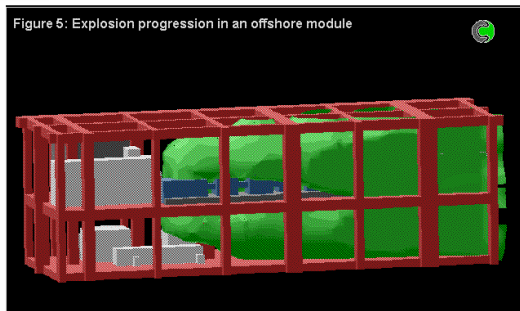
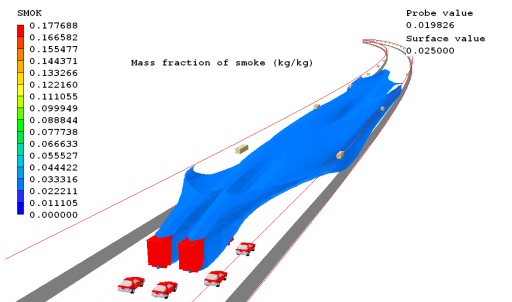
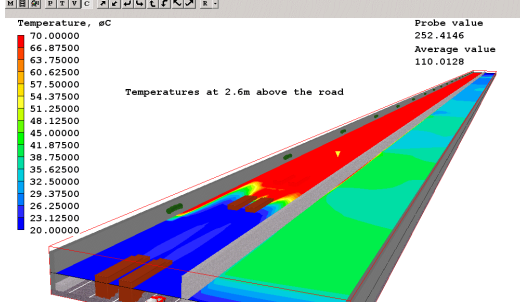


Figure 5: Explosion progression in an offshore module

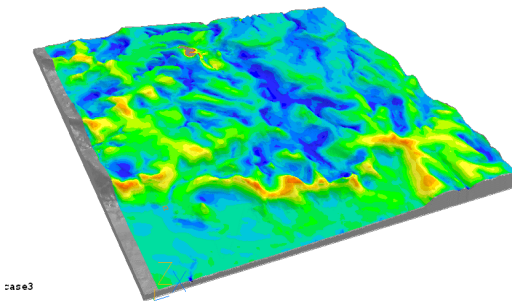
Explosion in offshore platform



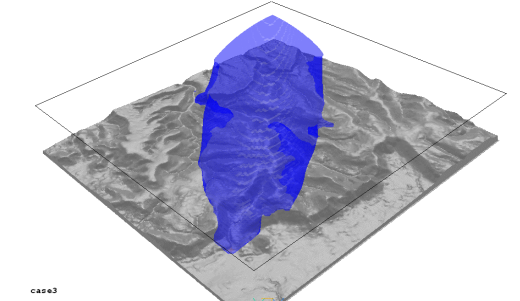
Smoke release from lorry fire in tunnel



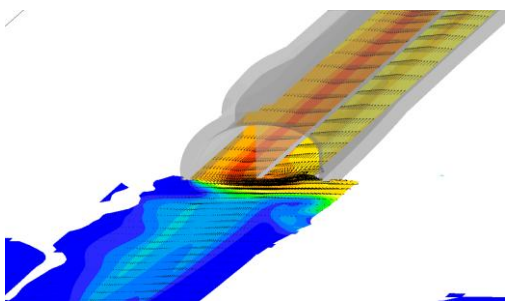
Air temperature from lorry fire in tunnel



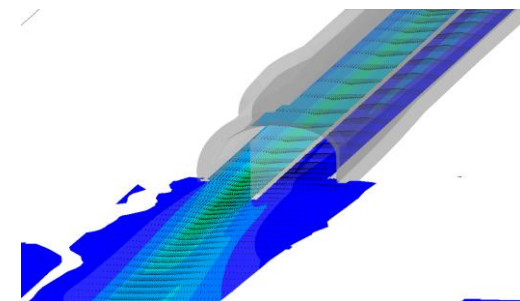
Wind velocity over hilly terrain



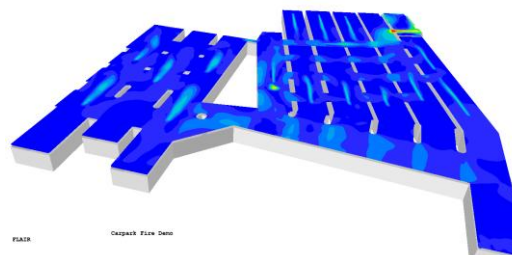
Gaseous chlorine release over hilly terrain



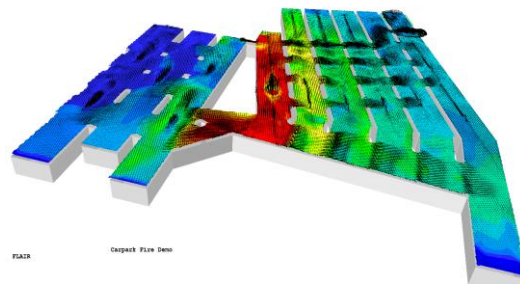
Nitrous oxide levels in road tunnel



Nitrous oxide levels after remedial action



Ventilation of car park



Velocity vectors coloured by temperature

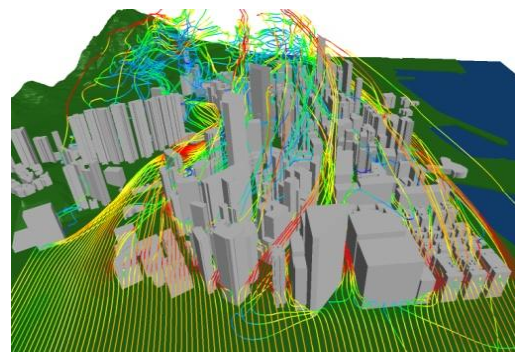


F

CFD Software for HVAC, Thermal Comfort, Internal & External Air Flow Modelling, plus Fire, Smoke and Hazard Simulation

L

PHOENICS/FLAIR is a CFD software package specializing in the simulation of scenarios involving fluid flow, heat transfer, combustion and chemical reaction processes occurring in the built and natural environment. FLAIR is utilized worldwide by architects, design engineers and safety officers concerned with the performance of air-flow systems for both the internal and external environment.



Hilly urban terrain (streamlines expanded view)

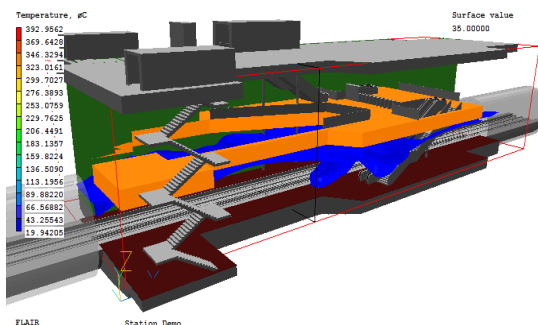
A

FLAIR enables users to visualise, understand, evaluate and refine the air-flow patterns in steady state or time dependant scenarios, in micro- as well as macro-scale. FLAIR permits the safe investigation of "what-if" scenarios involving ventilation system failures, fires, explosions, gas and chemical releases, and the subsequent effect of remedial action.

FLAIR shows results for:

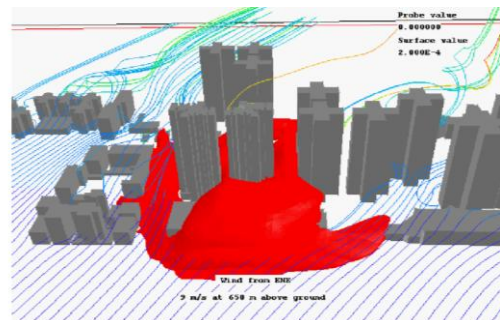
- Air-flow patterns
 - Velocity
 - Pressure
 - Temperature
 - Turbulence
- Temperature distribution / stratification
- Radiation
- Humidity
- Thermal comfort (PPM, PPD, etc)
- Age of air / residence time
- Air change effectiveness
- Smoke layering and concentration
- Visibility / line of sight
- Pollutant spread and concentration
- Transport of contaminants
- Effect of sprinkler and fan fire control methods

I

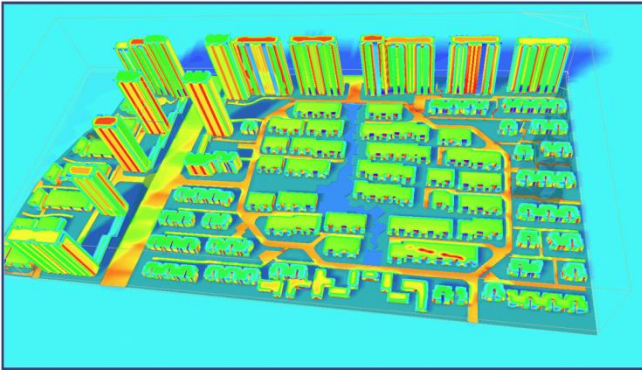


R

Smoke progression in an underground railway station



Pollution spread around buildings



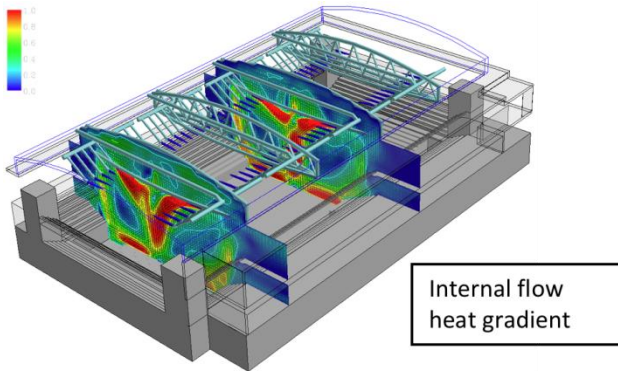
Surface temperature – urban heat island application

FLAIR contains:

- CAD import and repair features
- Standard objects for diffusers, fans, sprinklers and other equipment types
- Heat sources, inlet, outlet and other boundary conditions
- Wind and wind proofing
- Solar gain
- ISO, Green Star and ASHRAE standards
- Library of materials
- Property database
- Interface to weather database

FLAIR permits addition of user defined:

- Functions
- Materials
- Properties



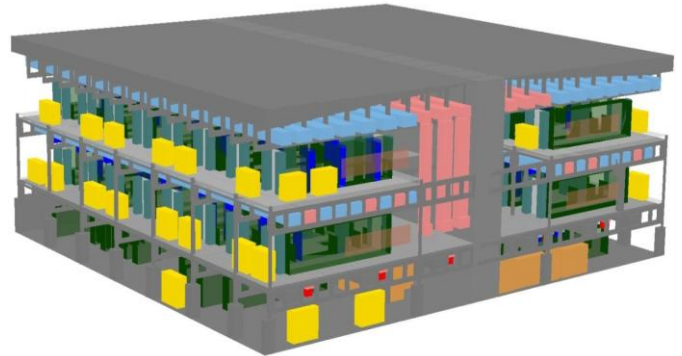
Internal flow heat gradient

FLAIR applications include:

- Heating, ventilation and air conditioning
- Thermal comfort
- Fire and smoke hazards
- Chemical release and pollution spread
- Wind loading on structures

FLAIR displays:

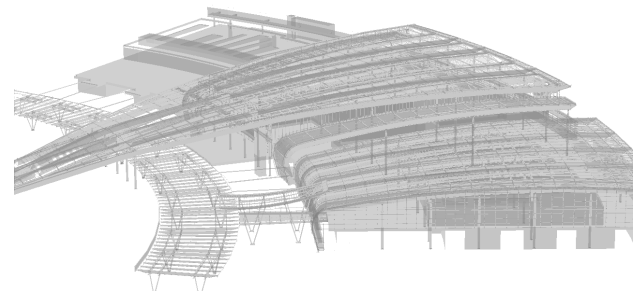
- Building geometry and terrain data
- Velocity vectors
- Streamlines
- Iso surfaces
- Contours of pressure, temperature, relative humidity, concentration and thermal comfort



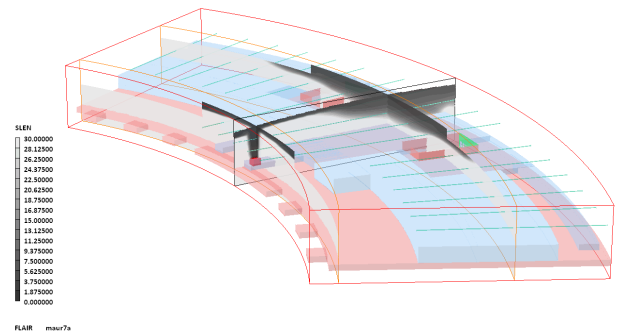
Data centre analysis

FLAIR cases include:

- Air ventilation assessment (AVA)
- Atria and building complexes
- Car parks
- Clean rooms and data centres
- Furnaces and incinerators
- Railway stations
- Sports stadia
- Cityscape street canyons
- Urban heat islands (UHI)
- Road and rail tunnels



Airport terminal imported from CAD & smoke progression cross-sections



SLEH
30.00000
28.12500
26.25000
24.37500
22.50000
20.62500
18.75000
16.87500
15.00000
13.12500
11.25000
9.37500
7.50000
5.62500
3.75000
1.87500
0.00000

FLAIR mnu7a