

MOLD DESIGN METHOD AND SYSTEM**Field Of Invention**

The present invention relates generally to a method and system for designing a mold.

- 5 Specifically, the present invention relates to a method for generating a mold for use in an injection molding process.

Background

- 10 A mold is typically used for producing a plastic part reproduction of an object. The mold conventionally comprises a mold core and mold cavity cooperating to form a channel for molding the plastic part reproduction.

- 15 The design of the mold, comprising of the mold core and the mold cavity, using a conventional mold design system requires a user to manually identify at least one parting line for generating a parting surface. This process is time-consuming and vulnerable to errors made by the user. As the geometry of the parting surface affects the surface quality of plastic part reproduction, the parting surface for the mold has to be accurately generated.

- 20 Furthermore, the user has to manually identify the presence of any undercut or crossover features on the object and to manually define these using a graphical user interface. Improper definition of these features and the parting surfaces can result in an unusable mold being produced. Such a system is described in United States Patent No. 5,812,402 by Nishiyama.

- 25 Nishiyama describes an injection mold design system for correcting a profile of a product to be fabricated into a releasable profile from a mold. An injection mold is then designed based on the corrected product shape. The injection mold design system provides an inputting means for correcting the product shape or the mold profile. In Nishiyama, the mold is manually designed and is dependent solely on the intuition and experience of a user of the mold design system.
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Conventional mold design system also requires the user to manually define hole-lines for defining apertures that exist in the object. The hole-lines have to be manually segregated from other parting lines to enable a hole-filling algorithm to automatically fill the identified apertures.

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United States Patent Application Publication No. US2001/0018622A1 by Asano describes a mold design system for determining a parting line. In Asano, a two-dimensional projection system produces two-dimensional projection data by projecting edges of a product shape represented by three-dimensional graphics data onto a plane perpendicular to the mold opening direction, and to determine a parting line from the projection. A mold is then automatically generated from the parting line. However, no method was provided in Asano for determining modability of the product shape.

10 Furthermore, conventional mold design systems simultaneously present computer models of the object, the mold core and the mold cavity to the user, which thereby diminishes the ability of the user to analyse the designed mold core and mold cavity.

15 Hence, this clearly affirms a need for a mold design method and system for addressing the foregoing disadvantages of conventional mold design systems.

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Summary

5 An embodiment of the invention automatically detects at least one parting line for an object and automatically detects surface features and the ejection axis for facilitating the design and generation of a mold. The use of z-map based representation for the object facilitates moldability analysis of the generated mold. Furthermore, the embodiment of the invention modifies the opacity of a computer image of the object further facilitates analysis of the mold by a user.

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Therefore in accordance with a first aspect of the invention, there is disclosed a mold design method for generating a mold cavity and a mold core, the mold design method comprising the steps of:

15 generating an extended z-map for an object having a plurality of faces, the extended z-map comprising a first z-map and a second z-map, and each of the plurality of faces having at least one geometric feature;

determining the at least one geometric feature of each of the plurality of faces;

20 analysing the moldability of the object from the at least one geometric feature of each of the plurality of faces defined by the extended z-map, the moldability of the object indicating feasibility of generating the mold cavity and the mold core for molding the object; and

generating the mold cavity and the mold core of the object in response to the object being moldable upon analysing the moldability of the object.

25 In accordance with a second aspect of the invention, there is disclosed a mold design system for generating a mold cavity and a mold core, the mold design system comprising:

30 means for generating an extended z-map for an object having a plurality of faces, the extended z-map comprising a first z-map and a second z-map, and each of the plurality of faces having at least one geometric feature;

means for determining the at least one geometric feature of each of the plurality of faces;

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means for analysing the moldability of the object from the at least one geometric feature of each of the plurality of faces defined by the extended z-map, the moldability of the object indicating feasibility of generating the mold cavity and the mold core for molding the object; and

- 5 means for generating the mold cavity and the mold core of the object in response to the object being moldable upon analysing the moldability of the object.

Brief Description Of The Drawings

- 10 Embodiments of the invention are described hereinafter with reference to the following drawings, in which:

FIG. 1 shows a process flow diagram of a mold design method according to an embodiment of the invention;

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FIG. 2 shows a front sectional view of an object designed and generated using the mold design method of FIG. 1;

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FIG. 3 shows a front sectional view of the object of FIG. 2 represented by an extended z-map generated by a mold design system implementing the mold design method of FIG. 2;

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FIG. 4 shows a process flow diagram of generating an extended z-map in a step of the mold design method of FIG. 1;

FIG. 5 shows a process flow diagram of determining geometric features of the object of FIG. 2 in a step of the mold design method of FIG. 1;

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FIG. 6 shows a process flow diagram of generating a mold core and a mold cavity for the object of FIG. 2 in a step of the mold design method of FIG. 1;

FIG. 7 shows a plan view a bounding box surrounding a parting line of the object of FIG. 2;

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FIG. 8 shows a plan view of the bounding box of FIG. 7 with a pair of cut-planes;

FIG. 9 shows a plan view of the bounding box of FIG. 7 with sub-surfaces extruded from the parting lines of FIG. 7;

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FIG. 10 shows a plan view of a parting surface generated from the sub-surfaces of FIG. 9;

FIG. 11 shows a process flow diagram of generating the parting surface of FIG. 10 for the object of FIG. 2;

FIG. 12 shows a process flow diagram of analysing the mold core and the mold cavity generated in the process of FIG. 6 in a step of the mold design method of FIG. 1;

FIG. 13 shows a perspective view of a cube for illustrating the process of analysing the mold core and the mold cavity of FIG. 12; and

FIG. 14 shows a perspective view of the cube of FIG. 13 employing a "see through" effect.

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Detailed Description

A mold design method for addressing the foregoing problems is described hereinafter.

5 An embodiment of the invention, a mold design method 100 is described with reference to FIG. 1, which shows a process flow diagram of the mold design method 100, FIG. 2, which shows a first front sectional view of an object 26, and FIG. 3, which shows a second front sectional view of the object 26. The mold design method 100 is implemented by a mold design system (not shown) for generating a mold
10 cavity 22 and a mold core 24. Reproductions of the object 26 are made using the mold cavity 22 and the mold core 24.

As shown in FIG. 3, the object 26 has a surface 28 formed by a plurality of faces 30. In the mold design method, an extended z-map 32 is generated for the object 26 in a
15 step 102 of FIG. 1. The extended z-map 32 is generated using an object representation method in the step 102. In the step 102, the mold design system obtains geometric data for the object 26 in a step 122 of FIG. 4. FIG. 4 shows a process flow diagram of generating the extended z-map 32. The geometric data, for example 3-D coordinates, is representative of the object 26. A z-map plane 34 is first
20 generated in a step 124.

The geometric data of the object 26 is preferably represented in one of standard template library (STL) format or XGL format. The STL format provides a standard template for representing parameters of the object 26. The object 26 and its
25 parameters are easily recognisable for data conversion as declarations within an STL data set which abides by a standard format. XGL is a file format designed for representing 3D information for the purpose of visualisation. The XGL format, which uses the XML format, substantially captures all 3D information that can be rendered by Silicon Graphics Incorporated's (SGI) OpenGL rendering library. Similar to the
30 STL format, the XGL format is typically used when data must be exchanged between two graphics systems.

In a step 126 of FIG. 4, a first z-map 36 and a second z-map 38 are generated from the geometric data of the object 26 by first extracting mesh data from the geometric data. The mesh data is generally indicative of the surface 28 of the object 26. Using one of the STL or XGL format to represent the geometric data of the object 26 facilitates the extraction of the mesh data from the geometric data. The first z-map 36 and the second z-map 38 are generated with reference to the z-map plane 34. Each of the first and second z-maps 36/38 has a plurality of primary grid points 40, each of the plurality of primary grid points 40 having a z-value, being indicative of at least one of the plurality of faces 30. The plurality of primary grid points 40 are coincident with a corresponding the z-map plane 34.

In a step 128 of FIG. 4, an extended map 42 is generated for each of the first and second z-map 36/38 of the z-map plane 34. The extended map 42 comprises a plurality of secondary grid point 44 spaced between at least one pair of primary grid points 40. Each secondary grid points 44 has an e-value being indicative of at least one of the plurality of faces 30 having intricate features. The extended map 42 provides for higher resolution for representing the intricate features. In the foregoing manner, the steps 122 to 128 describe an embodiment of the object representation method.

The mold design method 100 requires that at least one geometric feature be determined for each of the plurality of faces 30 in a step 104 as shown in FIG. 1, which shows a process flow diagram of determining the at least one geometric feature. In the step 104, at least one of the plurality of faces 30 indicated by the first z-map 36 is grouped to form a cavity face 48 in a step 132 of FIG. 5. In a step 134, at least one of the plurality of faces 30 indicated by the second z-map 38 is grouped to form a core face 50.

The mold design system proceeds to analyse the moldability of the object 26 in a step 106 of FIG. 1 in response to the geometric feature, comprising the cavity face 48 and the core face 50 identified in the step 104.

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In the step 106, removability of the object 26 from the mold cavity 22 and mold core 24 is determined by analysing the z-values and e-values of the corresponding primary grid points 40 and secondary grid points 44 of the first and second z-maps 36/38. The removability of the object 26, determined in relation to the first and second z-maps 36/38, is the ability for the object to be removed from the mold cavity 22 and mold core 24 without the mold cavity 22 or the mold core 24 obstructing any of the plurality of faces 30 of the object 26. Once the object 26 is determined as being removable from the mold cavity 22 and mold core 24, the object 26 is determined as being moldable.

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Additionally, the step 106 includes identifying undercut features from the plurality of faces 30. The undercut features are identified as at least one face 30 constituting the surface 28 of the object 26 that is not indicated by one of the first z-map 36 and the second z-map 38. It is essential to identify undercut features as an injection molding machine (not shown) requires sliders and lifters to produce the undercut features. The lifters and sliders translate into higher production cost.

Additionally, the step 106 includes identifying crossover faces (not shown) from the plurality of faces 30. Each crossover face is one of the plurality of faces 30 extending between the cavity face 48 and the core face 50 and being grouped to form both the cavity face 48 and the core face 50.

The mold design system proceeds to generate the mold cavity 22 and the mold core 24 in a step 108 of FIG. 1 in response to the object 26 being moldable as analysed in the step 106. A process flow diagram of generating the mold cavity 22 and the mold core 24 in the step 108 is shown in FIG. 6. In the step 106 of FIG. 1, the mold design system identifies at least one parting line 60 from the object 26 in a step 140 of FIG. 6. In the step 140, an ejection axis 61 is generated with reference to the z-map plane 34 as shown in FIG. 2 with the ejection axis 61 being generally perpendicular to the z-map plane 34. The ejection axis 61 is an axis along which a molded object (not shown) received onto a mold is removable from the mold.

Following the generation of the ejection axis 61, the at least one parting line 60 is generated in the step 140 using a parting line algorithm. Each of the at least one parting line 60 defines a portion of a periphery of an interface between the cavity face 48 and the core face 50. Each of the at least one parting line 60 is categorised as one of an external parting line and an internal parting line in a step 142.

Next, the mold design system identifies a presence of at least one aperture in the object 26 in a step 144. The at least one aperture is identified from the parting line 60 being categorised as the internal parting line. Each internal parting line forms a periphery of a corresponding one aperture. The at least one aperture is filled to eliminate the corresponding at least one aperture in a step 145 of FIG. 6. The at least one aperture is filled using a known filling algorithm pre-defined in the mold design system.

In the step 108, the mold design system constructs a parting surface 68 in a step 146, with the parting surface 68 being constructed from the at least one parting line 60 being categorised as an external parting line.

With reference to FIGS. 7 to 11, the parting surface 68 is generated by first constructing a bounding box 69a in a step 160 of FIG. 11 which shows a process for generating the parting surface 68 in the step 146. With reference to FIG. 7, the bounding box 69a comprises of four lines interconnected to form a rectangular periphery. A vertex 69b is formed coincident with a point where an extremity of one line connects with an extremity of another line. Four vertices 69b are formed from the four lines of the bounding box 69a. The bounding box 69a is planar and generally parallel to the at least one parting line 60. The bounding box 69a is dimensioned for completely receiving the at least one parting line 60 therein.

In a step 162 of FIG. 11, a pair of cut-planes 69c are generated and positioned within the bounding box 69a as shown in FIG. 8. The pair of cut-planes 69c is generally perpendicular to a plane formed by the lines of the bounding box 69a. Each cut-plane 69c extends between each pair of vertices 69b having the furthest distance apart. Each cut-plane 69c intersects the at least one parting line 60 at two transition points

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69d, with the pair of cut-planes 69c providing four transition points 69d. The transition points 69d segregates the at least one parting line 60 into four boundary lines, each boundary line extending between each adjacent pair of transition points 69d.

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With reference to FIG. 9, a sub-surface 69e is extruded from each boundary line in outwardly opposing directions in a step 164 of FIG. 11. Each of the extruded sub-surface 69e extends from the boundary line to the corresponding line of the bounding box 69a. The sub-surfaces 69e are then combined to form the parting surface 68 by
10 extruding and joining adjacent sub-surfaces 69e as shown in FIG. 10 in a step 166 of FIG. 11.

In response to the step 146 of FIG. 6, the mold design system forms the mold core 24 on a core block 70 and the mold cavity 22 in the cavity block 72 in a step 148. The
15 core block 70 and cavity block 72 are shown in FIG. 2. The mold cavity 22 is constructed from the parting surface 68 and cavity face 48 with the mold cavity 22 being generally a cavity formed in the cavity block 72, and the mold cavity 22 having a surface profile of the cavity face 48. Additionally, the mold core 24 is constructed from the parting surface 68 and the core face 50 with the mold core 24 being
20 generally a protrusion formed on the core block 70, and the mold core 24 having a surface profile of the core face 50.

The mold design method 100 further includes a step 110 of FIG. 1, of analysing the generated mold cavity 22 and mold core 24 by a user. FIG. 12 shows a process flow
25 diagram of analysing the generated mold cavity 22 and the mold core 24 according to the step 110. In the step 110, the mold design system receives at least one input from the user in a step 150. The at least one input includes at least one of a zoom factor, an object orientation and an object position. In a step 152, the mold design system renders an image of the mold cavity 22 and the mold core 24 in accordance to the at
30 least one input received from the user. In response to the step 152, the mold design system displays the rendered image on a display device 78, for example a computer monitor, for viewing and analysis by the user in a step 154.

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The at least one input received from the user in the step 150 further includes an opacity index. The images of the mold cavity 22 and the mold core 24 are further rendered, in the step 152, with an opacity defined by the opacity index. By varying the opacity index, the core block 70 and cavity block 72 is rendered transparent in the image for display to the user, thereby allowing the user to "see-through" the core block 70 and the cavity block 72 for facilitating the analysis of both the mold cavity 22 and the mold core 24. The mold cavity 22 and the mold core 24 are rendered opaque for facilitating analysis of the mold cavity 22 and the mold core 24. The parting surface 68 is displayed as a wire-frame model on the display device 78 in order not to obstruct the mold core 24 and mold cavity 22 from the view of the user.

The "see through" effect is illustrated in FIGS. 13 and 14. FIG. 13 shows a perspective view of a cube 200 with a corner 202 hidden from view. In FIG. 13, solid lines indicate visible lines and dashed lines indicate hidden lines. By varying the opacity index of the cube 200, the interior of the corner 202 can then be readily seen as illustrated in FIG. 14. Similar to FIG. 13, solid lines indicate visible lines and dashed lines indicate hidden lines in FIG. 14. The "see through" effect of FIG. 14 allows the hidden corner 72 to be readily viewed and analysed.

Further in the step 154 of FIG. 12, the mold cavity 22 and the mold core 24 are rendered in an exploded view in response to receiving further input from the user. In the exploded view, the core block 70 is displaced a distance from the cavity block 72 with the mold cavity 22 opposing the mold core 24 and the object 26 positioned between the core block 70 and the cavity block 72. The image of the exploded cavity block 72 and core block 70 is virtually rotated by varying the object orientation through the at least one input by the user.

In the foregoing manner, the mold design method and system is described according to an embodiment of the invention for addressing the foregoing disadvantages of conventional practices for designing molds. Although only one embodiment of the invention is disclosed, it will be apparent to one skilled in the art in view of this disclosure that numerous changes and/or modification can be made without departing from the scope and spirit of the invention.

Claims

1. A mold design method for generating a mold cavity and a mold core, the mold design method comprising the steps of:
generating an extended z-map for an object having a plurality of faces,
5 the extended z-map comprising a first z-map and a second z-map, and each of the plurality of faces having at least one geometric feature;
determining the at least one geometric feature of each of the plurality of faces;
analysing the moldability of the object from the at least one geometric
10 feature of each of the plurality of faces defined by the extended z-map, the moldability of the object indicating feasibility of generating the mold cavity and the mold core for molding the object; and
generating the mold cavity and the mold core of the object in response to the object being moldable upon analysing the moldability of the object.
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2. The mold design method as in claim 1, further comprising a step of:
analysing the generated mold cavity and mold core by a user.
3. The mold design method as in claim 1, the step of generating an extended z-
20 map for an object comprising the steps of:
obtaining geometric data being representative of the object;
generating a z-map plane;
constructing the first z-map of the object from the geometric data, the
first z-map having a plurality of primary grid points and being constructed
25 with reference to the z-map plane, each of the plurality of primary grid points having a z-value and the plurality of primary grid points being indicative of at least one of the plurality of faces; and
constructing the second z-map of the object from the geometric data,
the second z-map having a plurality of primary grid points and being
30 constructed with reference to the z-map plane, each of the plurality of primary grid points having a z-value and the plurality of primary grid points being indicative of at least one of the plurality of faces.

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4. The mold design method as in claim 3, the step of generating an extended z-map for an object further comprising a step of:
- generating an extended map comprising a plurality of secondary grid points disposed between at least one pair of the plurality of primary grid points of one of the first z-map and the second z-map.
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5. The mold design method as in claim 3, the step of analysing moldability of the object comprising the steps of:
- determining removability of the object from the mold core and the mold cavity, the removability being determined by analysing the plurality of faces of the object; and
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- acknowledging the moldability of the object in response to acknowledgement of the removability of the object from the mold core and mold cavity.
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6. The mold design method as in claim 3, the step of generating the mold cavity and the mold core of the object comprising the steps of:
- generating an ejection axis from one of the z-map plane, the ejection axis being an axis along which the object when received onto a mold is removable from the mold;
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- identifying at least one parting line from the object, the at least one parting line constituting a portion of the periphery of an interface between the cavity face and the core face;
- categorising the at least one parting line as one of an external parting line and an internal parting line;
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- identifying presence of at least one aperture in the object, the presence of at least one aperture being at least one of the at least one parting line being categorised as an internal parting line;
- filling the at least one aperture and thereby eliminating the corresponding at least one aperture; and
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- constructing a parting surface from the at least one parting line.

7. The mold design method as in claim 6, the step of constructing a parting surface from the at least one parting line comprising the steps of:

constructing a bounding box having four vertices, the bounding box being dimensioned for receiving the at least one parting line therewithin and the four vertices being coincident with a plane being parallel to the z-map plane;

extending a cut-plane between each furthest pair of the four vertices, each cut-plane intersecting the at least one parting line at two transition points and each pair of adjacent transition points constituting extremities of a boundary line, the boundary line being a portion of the at least one parting line;

extruding a sub-surface from each boundary line towards a periphery of the bounding box; and

extruding and joining adjacent sub-surfaces to form the parting surface.

8. The mold design method as in claim 6, the step of generating the mold cavity and the mold core of the object further comprising the steps of:

grouping the at least one of the plurality of faces indicated by the first z-map to form a cavity face;

grouping the at least one of the plurality of faces indicated by the second z-map to form a core face;

constructing the mold cavity from the parting surface and cavity face, the mold cavity being generally a cavity formed in the cavity block and having a surface profile of the cavity face; and

constructing the mold core from the parting surface and core face, the mold core being a protrusion formed on the core block and having a surface profile of the core face,

wherein when the core block abuts the cavity block at the parting surface, the mold core integrates with the mold cavity for receiving the object therebetween.

9. The mold design method as in claim 6, the step of analysing moldability of the object comprising a step of:

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identifying undercut features from the plurality of faces, the undercut features being at least one of the plurality of faces not indicated by one of the first z-map and the second z-map.

- 5 10. The mold design method as in claim 6, the step of analysing moldability of the object comprising a step of:

identifying crossover faces from the plurality of faces, the crossover faces being at least one of the plurality of faces extending between the cavity face and the core face.

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11. The mold design method as in claim 2, the step of analysing the generated mold cavity and mold core by a user comprising the steps of:

receiving at least one input from the user, the at least one input comprising at least one of a zoom factor, an object orientation and an object position;

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rendering an image of the mold cavity and mold core in accordance to the at least one input received from the user; and

displaying the image on a display device for viewing by the user.

- 20 12. The mold design method as in claim 11, the at least one input received from the user further comprising an opacity index, and the image is rendered with both the mold cavity and mold core having an opacity defined by the opacity index.

- 25 13. A mold design system for generating a mold cavity and a mold core, the mold design system comprising:

means for generating an extended z-map for an object having a plurality of faces, the extended z-map comprising a first z-map and a second z-map, and each of the plurality of faces having at least one geometric feature;

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means for determining the at least one geometric feature of each of the plurality of faces;

means for analysing the moldability of the object from the at least one geometric feature of each of the plurality of faces defined by the extended z-

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map, the moldability of the object indicating feasibility of generating the mold cavity and the mold core for molding the object; and

means for generating the mold cavity and the mold core of the object in response to the object being moldable upon analysing the moldability of the object.

14. The mold design system as in claim 13, further comprising:

means for analysing the generated mold cavity and mold core by a user.

15. The mold design system as in claim 13, the means for generating an extended z-map for an object comprising:

means for obtaining geometric data being representative of the object;

means for generating a z-map plane;

means for constructing the first z-map of the object from the geometric data; the first z-map having a plurality of primary grid points and being constructed with reference to the z-map plane, each of the plurality of primary grid points having a z-value and the plurality of primary grid points being indicative of at least one of the plurality of faces; and

means for constructing the second z-map of the object from the geometric data, the second z-map having a plurality of primary grid points and being constructed with reference to the z-map plane, each of the plurality of primary grid points having a z-value and the plurality of primary grid points being indicative of at least one of the plurality of faces.

16. The mold design system as in claim 15, the means for generating an extended z-map for an object further comprising:

means for generating an extended map comprising a plurality of secondary grid points disposed between at least one pair of the plurality of primary grid points of one of the first z-map and the second z-map.

17. The mold design system as in claim 15, the means for analysing moldability of the object comprising:

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means for determining removability of the object from the mold core and the mold cavity, the removability being determined by analysing the plurality of faces of the object; and

5 means for acknowledging the moldability of the object in response to acknowledgement of the removability of the object from the mold core and mold cavity.

18. The mold design system as in claim 15, the means for generating the mold cavity and the mold core of the object comprising:

10 means for generating an ejection axis from one of the z-map plane, the ejection axis being an axis along which the object when received onto a mold is removable from the mold;

means for identifying at least one parting line from the object, the at least one parting line constituting a portion of the periphery of an interface
15 between the cavity face and the core face;

means for categorising the at least one parting line as one of an external parting line and an internal parting line;

means for identifying presence of at least one aperture in the object, the presence of at least one aperture being at least one of the at least one
20 parting line being categorised as an internal parting line;

means for filling the at least one aperture and thereby eliminating the corresponding at least one aperture; and

means for constructing a parting surface from the at least one parting
25 line.

19. The mold design system as in claim 18, the means for constructing a parting surface from the at least one parting line comprising:

means for constructing a bounding box having four vertices, the bounding box being dimensioned for receiving the at least one parting line
30 therewithin and the four vertices being coincident with a plane being parallel to the z-map plane;

means for extending a cut-plane between each furthest pair of the four vertices, each cut-plane intersecting the at least one parting line at two

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transition points and each pair of adjacent transition points constituting extremities of a boundary line, the boundary line being a portion of the at least one parting line;

5 means for extruding a sub-surface from each boundary line towards a periphery of the bounding box; and

means for extruding and joining adjacent sub-surfaces to form the parting surface.

20. The mold design system as in claim 17, the means for generating the mold cavity and the mold core of the object further comprising:

10 means for grouping the at least one of the plurality of faces indicated by the first z-map to form a cavity face;

means for grouping the at least one of the plurality of faces indicated by the second z-map to form a core face;

15 means for constructing the mold cavity from the parting surface and cavity face, the mold cavity being generally a cavity formed in the cavity block and having a surface profile of the cavity face; and

means for constructing the mold core from the parting surface and core face, the mold core being a protrusion formed on the core block and having a surface profile of the core face,

20 wherein when the core block abuts the cavity block at the parting surface, the mold core integrates with the mold cavity for receiving the object therebetween.

25 21. The mold design system as in claim 18, the means for analysing moldability of the object comprising:

means for identifying undercut features from the plurality of faces, the undercut features being at least one of the plurality of faces not indicated by one of the first z-map and the second z-map.

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22. The mold design system as in claim 18, the means for analysing moldability of the object comprising:

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means for identifying crossover faces from the plurality of faces, the crossover faces being at least one of the plurality of faces extending between the cavity face and the core face.

- 5 23. The mold design system as in claim 14, the means for analysing the generated mold cavity and mold core by a user comprising:

means for receiving at least one input from the user, the at least one input comprising at least one of a zoom factor, an object orientation and an object position;

- 10 means for rendering an image of the mold cavity and mold core in accordance to the at least one input received from the user; and

means for displaying the image on a display device for viewing by the user.

- 15 24. The mold design system as in claim 23, the at least one input received from the user further comprising an opacity index, and the image is rendered with both the mold cavity and mold core having an opacity defined by the opacity index.

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