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A flying start towards minimizing removal times
邁向最小取出時間

The production process for making injection-molded plastic parts consists of innumerable phases which all have an effect on the total cycle time. One of these is the finished parts removal sequence, where the ***minimization of mold-open time*** *contributes substantially to shortening the cycle time.*

射出成型塑料零件的生產過程由無數階段組成，這些階段均會影響總循環週期。其中之一是成品的取出時間，其中最短的開模時間有助於縮短總循環週期。

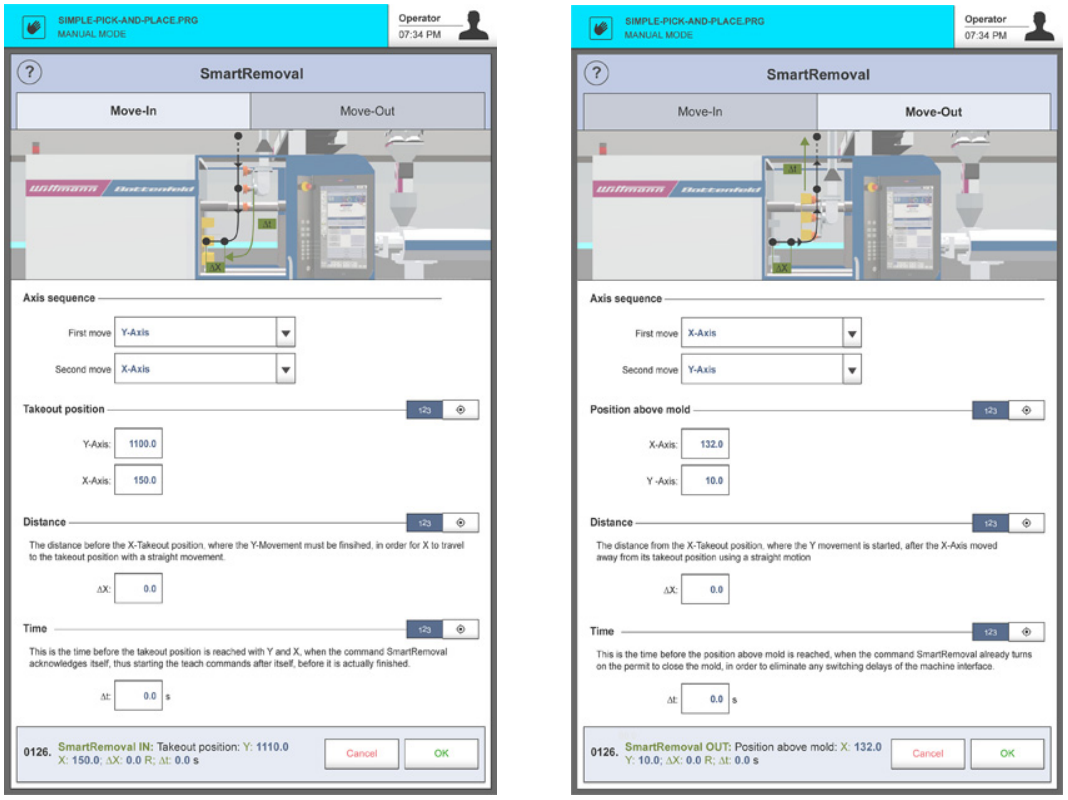
Visualization of a removal procedure. 成品取出可視化。

Modern robot systems offer the advantages of highly efficient motors and weight-optimized axes. Here, WITTMANN uses a well-balanced material mix of thin steel sheet combined with aluminum. The choice of materials in each case depends on the specific application and the stroke length of the removal robots. The available model range covers highly rigid combinations for load capacities of up to 150 kg as well as weight-optimized solutions for acceleration rates of up to 80 m/s².

創新的威猛機械手系統具有高效能伺服電機和輕量優化軸臂的優勢。在這裡，威猛採用了鋼板與鋁的混合材料。在不同情況下，材料的選擇取決於特定的應用和機械手的行程長度。可用的型號範圍涵蓋了高達 150 kg 的承重能力的高剛性組合，以及高達 80 m /s²的加速度優化的重量優化解決方案。

However, even the best design makes no difference unless the response times of the appliances are able to keep up with it. This is why WITTMANN has been operating with a 4 ms cycle time for several years, which is a vital factor in the command processing time of the robot's teach-program and thus constitutes an essential component of every WITTMANN robot application. All WITTMANN robots – from the compact models of the **PRIMUS** series right up to the large **WX** appliances – operate on the basis of this cycle time, regardless of the robot's actual control system version.
無論如何，威猛機械手一直保持最佳的設計來應對各種市場需求，除非生產設備的反應時間能夠跟上它。這就是威猛一直以 4 毫秒的循環周期時間運行多年的原因，這是自動控制裝置教導程序的命令處理時間的重要因素，因此構成了每個威猛機械手應用程序的重要組成部分。所有威猛自動控制裝置-從 PRIMUS 系列的緊湊型到大型 WX 設備-都在此循環時間的基礎上運行，不管機械手臂控制裝置的實際控制系統版本如何都是相同的設計理念。

Another significant aspect is the efficient conversion of command input and control signals into appropriate travel movements. This is where the patented ***SmartRemoval*** function from WITTMANN – installed in all robots as standard – shows its advantages. The main feature of ***SmartRemoval*** is its anticipatory inward movement of the robot axis – in top-entry models generally the vertical axis, and the horizontal axis in horizontal appliances.
另一個重要方面是將命令輸入和控制信號有效地轉換為適當的行程運動。這是威猛獲得專利的 SmartRemoval 功能的地方 - 標準安裝在所有機械手中 - 展現了其優勢。 SmartRemoval 的主要特徵是其預期的自動控制裝置軸向內移動 - 在頂部進入的模內中，通常為垂直軸，而在水平設備中為水平軸。



Input window for SmartRemoval Move In (left) and SmartRemoval Move Out on the WITTMANN R9 control system (W9 & WX series). SmartRemoval 移入（左側）和 SmartRemoval 移出的輸入窗口在威猛 R9 控制系統（W9 和 WX 系列）上。

R9 robot control system from WITTMANN, on the left with display of the home screen, on the right with display of a work cell connected to R9.
左側為帶顯示屏主屏幕的威猛R9自動控制裝置系統 / 右側為顯示連接到R9的工作單元

The analysis of the injection molding machine's cycle permits initiation of the anticipatory axial movement before the platen is completely opened. No special interface is required to carry out this analysis, since EUROMAP E12 (in older machine models) or EUROMAP E67 already provides the necessary signals for calculation. ***SmartRemoval*** makes it possible for the robot to reach its maximum speed in the mold area at a very early stage. By almost complete elimination of the acceleration phase after the moving mold platen has reached its end position, in combination with phased vacuum monitoring of the finished parts, mold-open times are reduced by 10 to 30 per cent.
通過對塑膠射出機循環的分析，可以在模板完全打開之前啟動預期的軸向運動。由於 EUROMAP E12（在較舊的機器型號中）或 EUROMAP E67 已經提供了計算所需的信號，因此不需要特殊的接口即可進行此分析。 SmartRemoval 使機械手可以在很早的階段就在模具區域達到其最大速度。通過在移動模板到達其最終位置後幾乎完全消除加速階段，結合對成品零件的分階段真空監控，可將開模時間減少 10%到 30%。

For complex parts which offer no facility for a stable hold in the ejector's end position and thus complicate the task of programming a safe transfer to the removal gripper, the WITTMANN robot control system provides a special feature known as the **Push** function. Another common form of this function found on the market for this type of requirements is releasing the brake on the robot's demolding axis. However, this can have an extremely adverse effect, since in such cases the ejector presses the part directly into the gripper and consequently onto the demolding axis. As a result, deformations and other defects may occur on the finished parts, and in the long run also damage the mechanism of the removal device. By contrast, the **Push** function from WITTMANN enables a gentle, torque-monitored transfer of the parts. Here, the actual presence of a finished part is continually monitored by what is known as the **iVac** function, the freely programmable vacuum monitoring system from WITTMANN. **iVac** offers the advantage of having the molded part picked up with only a fraction of the necessary vacuum pressure, together with a simultaneous start of the removal sequence. During the robot's outward movement, the vacuum pressure rises to the maximum level. As soon as the set reference pressure for the molded part has been reached, the release signal for closing the mold is given. This release can already take place several tenths of a second before the robot leaves the mold area. In this way, signal delays in the interface between the robot and the injection molding machine are compensated, thus minimizing the mold-open time.
對於複雜的零件，這些零件無法在頂真的最終位置中穩定保持，從而使安全轉移到拆卸夾持器的編程任務複雜化，威猛機械手控制系統提供了一種特殊功能，即"推動"功能。市場上針對此類需求的此功能的另一種常見形式是釋放機械手脫模軸上的製動器。但是，這可能會產生非常不利的影響，因為在這種情況下，頂出器會將零件直接壓入握爪，進而壓到脫模軸上。結果，在成品零

件上可能會發生變形和其他缺陷，並且從長遠來看也會損壞拆卸裝置的機構。相比之下，威猛的“推”功能可實現輕柔，受扭矩監控的零件轉移。在此，通過稱為 iVac 功能，從威猛的可自由編程的真空監控系統，連續監控成品的實際存在。 iVac 的優勢在於，只需用一小部分必要的真空壓力即可拾取成型零件，並同時開始取出程序。在機械手向外移動期間，真空壓力會上升到最大水平。一旦達到成型部件的設定參考壓力，就會發出用於關閉模具的釋放信號。在機械手離開模具區域之前，這種釋放可能已經發生了十分之幾秒。這樣，可以補償機械手和注塑機之間的接口中的信號延遲，從而最大程度地減少開模時間。

With the standard functions of the WITTMANN robot control system as described above, injection molders receive not only a sophisticated system for optimizing applications, but also continuous monitoring of manufacturing processes.
憑藉上述威猛機械手控制系統的標準功能，射出製模者不僅可以使用複雜的系統來優化應用，而且還可以連續監控製造過程。

The WITTMANN Group

The WITTMANN Group is a globally leading manufacturer of injection molding machines, robots and auxiliary equipment for processing a great variety of plasticizable materials – both plastic and non-plastic. The group of companies has its headquarters in Vienna, Austria and consists of two main divisions: WITTMANN BATTENFELD and WITTMANN. Following the principles of environmental protection, conservation of resources and circular economy, the WITTMANN Group engages in state-of-the-art process technology for maximum energy efficiency in injection molding, and in processing standard materials and materials with a high content of recyclates and renewable raw materials. The products of the WITTMANN Group are designed for horizontal and vertical integration into a Smart Factory and can be interlinked to form an intelligent production cell.

The companies of the group jointly operate eight production plants in five countries, and the additional sales companies at their 34 different locations are present in all major industrial markets around the world.

WITTMANN BATTENFELD pursues the continued strengthening of its market position as a manufacturer of injection molding machines and supplier of comprehensive modern machine technology in modular design. The product range of WITTMANN includes robots and automation systems, material handling systems, dryers, gravimetric and volumetric blenders, granulators, temperature controllers and chillers. The combination of the individual areas under the umbrella of the WITTMANN Group enables perfect integration – to the advantage of injection molding processors with an increasing demand for seamless interlocking of processing machines, automation and auxiliaries.

威猛集團是射出機、機械手和周邊輔助設備的全球領先製造商，用於加工各種可塑材料（包括塑料和非塑料）。威猛集團總部設在奧地利維也納，由兩個主要部門組成：威猛巴頓菲爾和威猛。威猛集團遵循環境保護、節約資源和循環經濟的原則，致力於最先進的工藝技術，以最大程度地提高注塑成型的能效，以及用於處理標準材料以及回收料和可再生原料含量高的材料。威猛集團的產品旨在將水平和垂直方向集成到智能工廠中，並且可以相互鏈接以形成智能生產單元。

威猛集團在全球 5 個國家設有 8 個生產工廠，其中 34 個直屬分公司銷售遍布全國所有主要工業市場。

威猛巴頓菲爾致力於不斷增強其作為注塑機製造商和模組化設計的綜合現代機械技術供應商的市場地位。威猛的產品系列包括機械手和自動化系統、中央供料系統、除濕乾燥機、秤重式和體積式的計量機、粉碎機、模具溫度控制器和冷卻器。威猛集團的結合已經使所有產品線連接為一體，提供塑料加工商在射出機、自動化和輔助設備的無縫接軌，成為尋求集成方面的所在優勢 -所有這些都以漸進的速度發生。

威猛台灣分公司針對客戶需求提供系統方案為主力；以技術性整合、技術性提供之「整合」系統，從技術提供、技術諮詢，服務、訓練工程師到位、不間斷服務及教育訓練之售服，從觀念、技術及加工條件之支援，來自奧地利總公司之技術支援等，滿足全面性服務。

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